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WAR MACHINE

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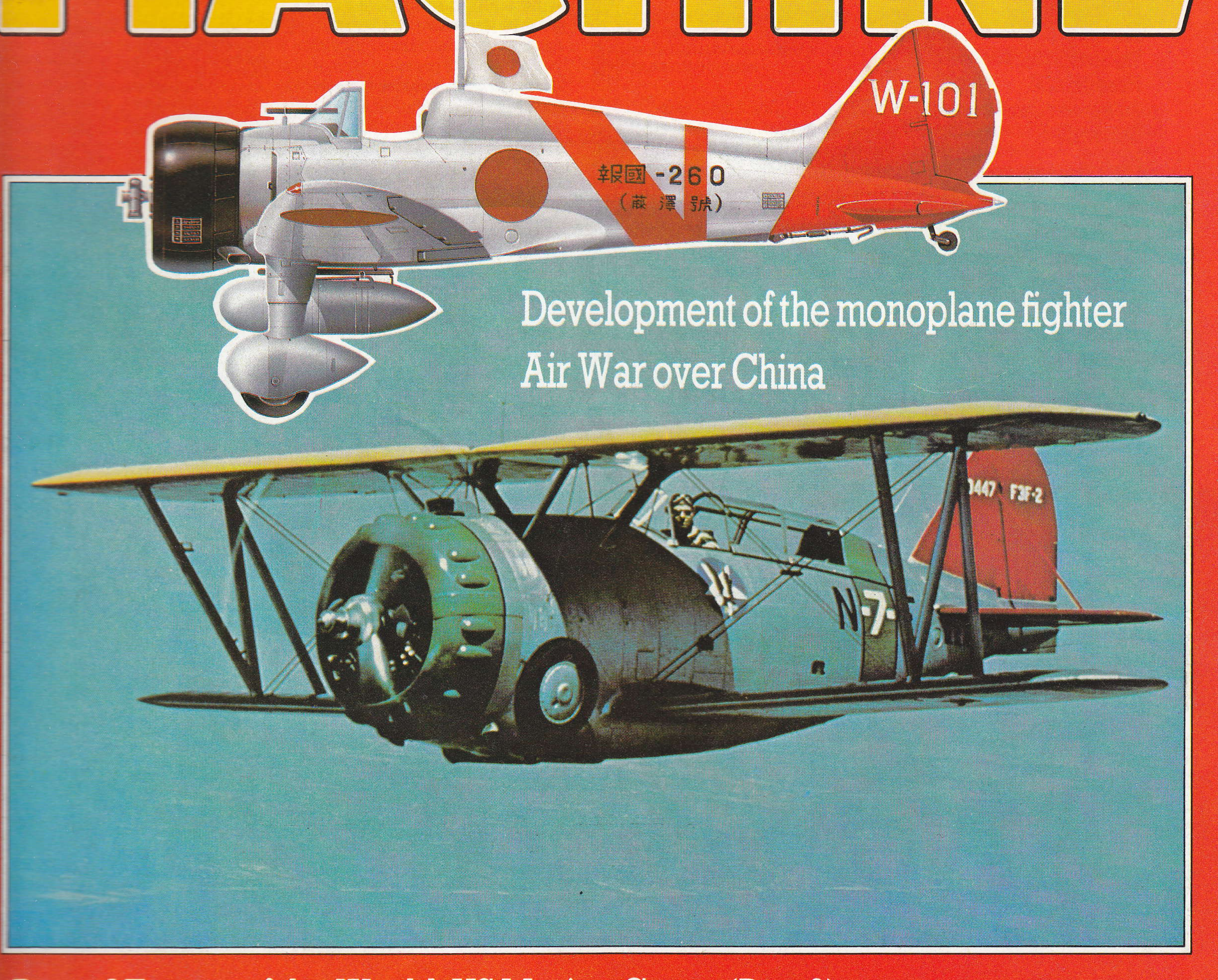

Development of the monoplane fighter

Air War over China

Armed Forces of the World: US Marine Corps (Part 3)

The Spanish Civil War

A fully illustrated guide to Inter-war Fighter Aircraft

WAR MACHINE

Volume 5 **Issue 59**

CONTENTS

Inter-war Fighters

Avia B 534 1162
Blériot-SPAD 510 1162
Dewoitine D.500 and D.510 1163
Heinkel He 51 1164
Fiat C.R.32 1164
The Spanish Civil War 1165
Mitsubishi A5M 1168
Air War over China 1172
Nakajima Ki-27 1174
PZL P.24 1174
Polikarpov I-15 1175
Polikarpov I-16 1176
Gloster Gauntlet 1176
Development of the monoplane fighter 1177
Gloster Gladiator 1178
Boeing P-26 1179
Seversky P-35 1179
Grumman F3F 1180

Armed Forces of the World

US Marine Corps (Part 3) iii

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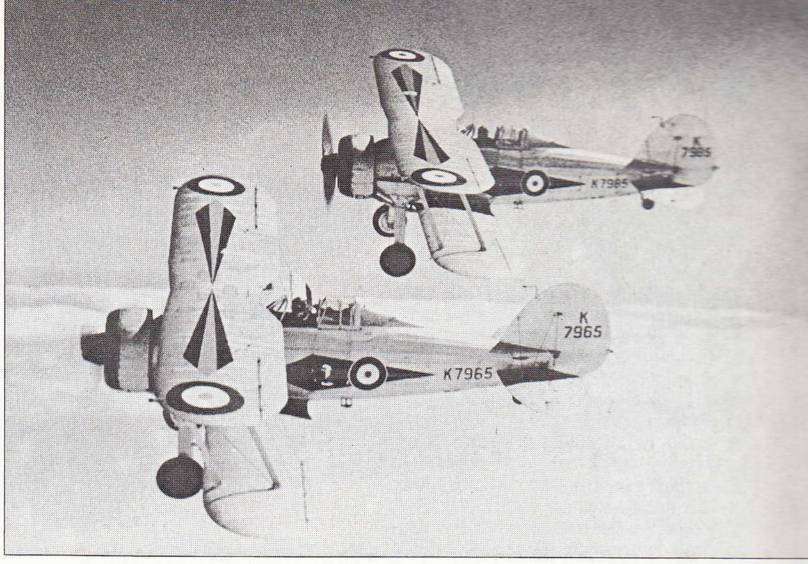
Inter-war Fighters

Few of the observers of the many dramatic air displays of the early 1930s could have foreseen that within a few short years the evolution of the fighter aircraft would have changed the agile biplanes, so little different from their World War I predecessors, into the potent machines of World War II.



The ultimate biplane fighter: the Gloster Gladiator featured a cowled engine and enclosed cockpit. The Gladiator served with the Royal Air Force during the late 1930s until replaced by the new breed of monoplane fighter, the Spitfire and Hurricane.

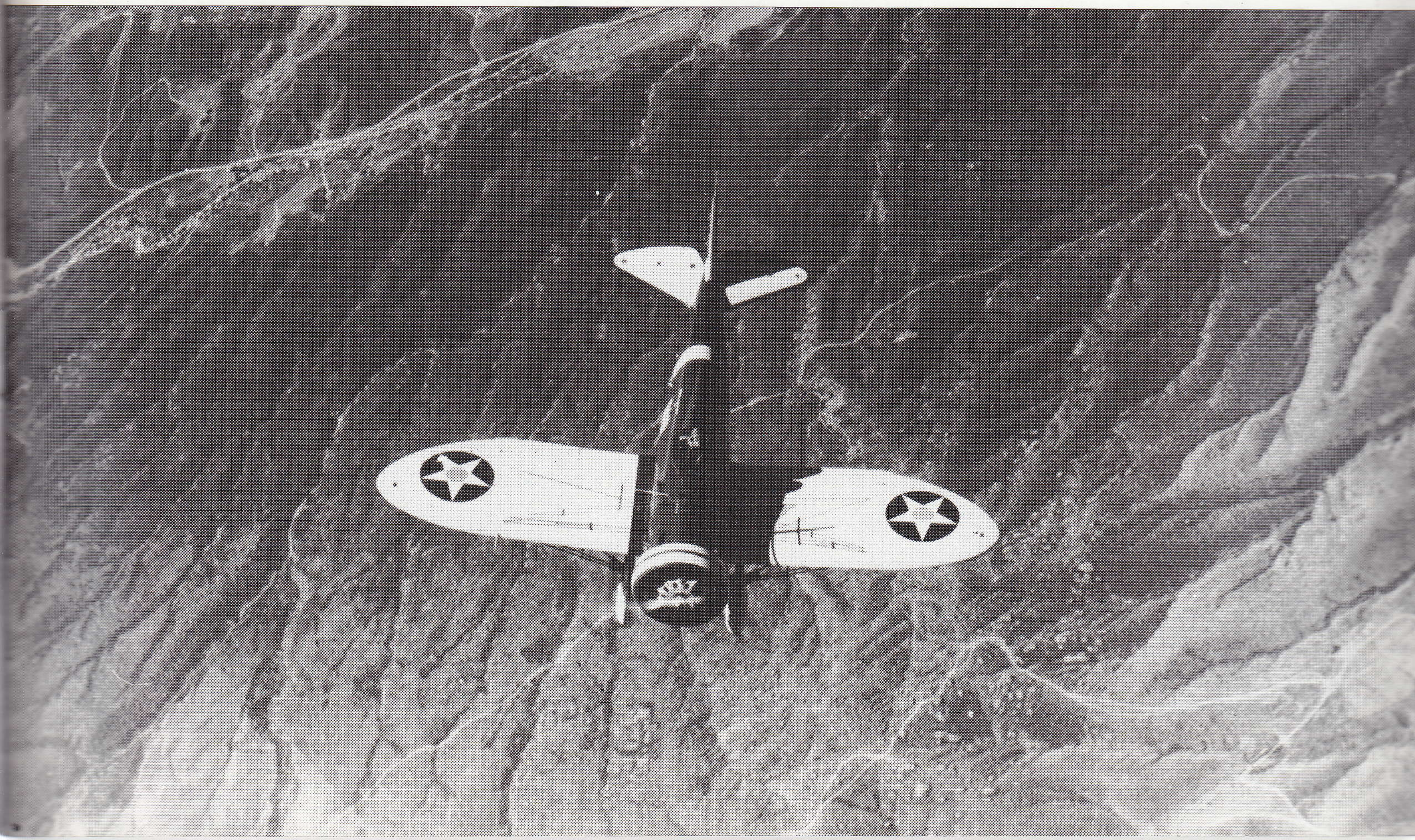
Measured by any standard (aircraft performance, complexity, lethality, cost or appearance) the 1930s were a time for rapid change in fighters. So too were the the 1940s, but that was mainly because of the introduction of jet propulsion. All the other advances that separate the scouts of World War I from the supersonic fighters of the 1950s were introduced in the decade that preceded World War II's outbreak in 1939.

During the 1920s almost nothing happened to fighter design apart from a rapid improvement in the power and reliability of engines. By the mid-1920s these were able to give 500 hp (373 kW) with very little likelihood of failure, resulting in biplane fighters that could reach almost 200 mph (322 km/h). A few were monoplanes, but these seldom showed any advantage in performance and were invariably inferior in manoeuvrability, and usually inferior in climb and ceiling. Not much happened in armament, apart from increasing acceptance of the shell-firing cannon firing through the hub of the propeller of a geared engine (which had often been used by Georges Guynemer in 1917). Another change was that a few services, such as the US Navy , hung bombs under fighters and trained the pilots in dive attacks, ancestors of today's 'dual-role fighters'.

Throughout the 1930s arguments raged. Most fighter pilots were adamant that a fighter should be a compact biplane with an open cockpit, able to out-turn and out-climb the enemy and eventually to shoot him down. With accurate shooting the rifle-calibre machine-gun was deadly, and it was light. What was the point in adding extra guns, or heavier guns, if their weight made the fighter incapable of bringing its guns to bear? There is some weight in this argument. At the Allies' darkest hour in World War II, in the desperate and hopeless fight for Singapore, the heavy 12.7-mm (0.5-in) guns in Brewster Buffalo fighters were replaced by puny 7.7-mm (0.303-in) weapons, with half-empty magazines, simply in order to try to dogfight successfully against the superior Mitsubishi A6M.

Suffice to say that not one of the traditional fighters designed for manoeuvrability in the early 1930s was able to make any impression on the best of the new stressed-skin monoplanes that first flew in 1935-6. The best of these were the Messerschmitt Bf 109 and Supermarine Spitfire, which quite quickly ended the reign of the types described here.

Typifying the changes in fighter design in the 1930s was the Boeing P-26. This aircraft still had the archaic braced wing and heavily-faired, non-retractable undercarriage but was one of the first to break with the biplane tradition.



CZECHOSLOVAKIA

Avia B 534

In its day the **Avia B 534** series of fighters were widely held to be the best ever designed, the team responsible being led by Ing. František Novotný. All B 534s had traditional structures with a wire-braced fuselage truss assembled from tubes, and with wings made mainly from steel strip, fabric-covered throughout except for the metal panels of the forward fuselage. Despite a massive water-cooled engine, with a high-drag radiator between the landing gears, the B 534 was so small that it had good performance and agility, and it also had better armament than most contemporary fighters.

The family started with the **B 34** of July 1932, made in small numbers. Production switched in 1934 to the **B 534.II** with many refinements and four guns in the sides of the fuselage. (A *moteur canon* was tested but shell feed caused problems.) After 200 aircraft with small differences, production moved in 1935 to the **B 534.III** and finally to the **B 534.IV** with sliding canopy and later engine with metal propeller. Streamlined skis could be attached in winter. Avia delivered 272 of the IV series, and 450 B 534 and cannon-armed **Bk 534** fighters were in service in 1938. Many saw action in the war with Hungary in March/April 1939, finding the enemy Fiat C.R.32s more agile. The Slovak air force then fought alongside the Luftwaffe and used many B 534s. In 1936 a single **B 634** had been flown, widely judged the cleanest and most beautiful of all biplane fighters, but no production ensued.

Specification

Avia B 534.IV

Type: single-seat biplane fighter-bomber

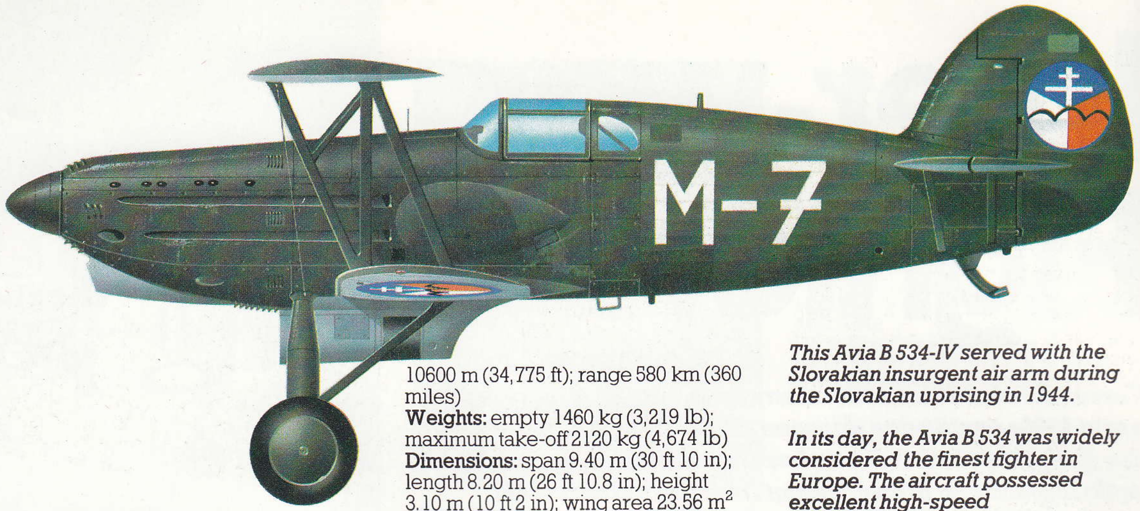
Powerplant: one 850-hp (634-kW) Avia-built HS 12Ydrs Vee-12 liquid-cooled piston engine

Performance: maximum speed 405 km/h (252 mph) at 4400 m (14,435 ft); climb to 5000 m (16,405 ft) in 4 minutes 28 seconds; service ceiling 10600 m (34,775 ft); range 580 km (360 miles)

Weights: empty 1460 kg (3,219 lb); maximum take-off 2120 kg (4,674 lb)

Dimensions: span 9.40 m (30 ft 10 in); length 8.20 m (26 ft 10.8 in); height 3.10 m (10 ft 2 in); wing area 23.56 m^2 (253.6 sq ft)

Armament: four 7.7-mm (0.303-in) or later 7.92-mm (0.31-in) Model 30 machine-guns, plus six 20-kg (44-lb) bombs



This Avia B 534-IV served with the Slovakian insurgent air arm during the Slovakian uprising in 1944.

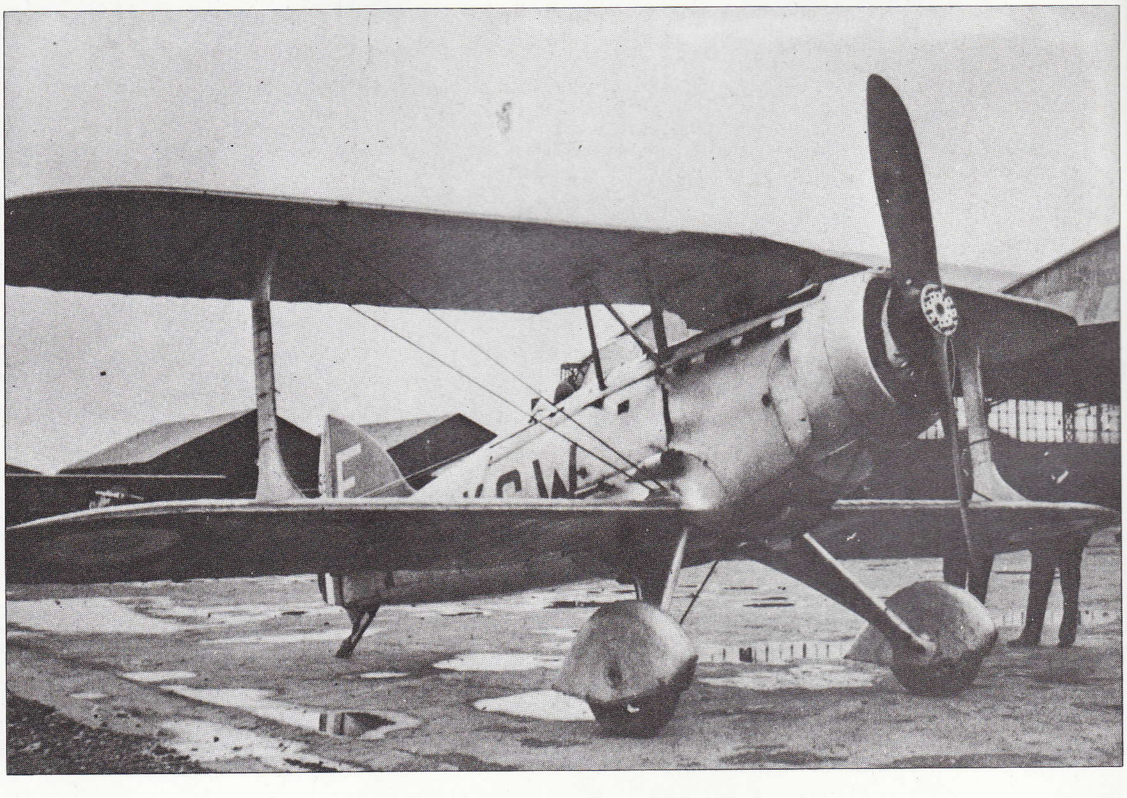
In its day, the Avia B 534 was widely considered the finest fighter in Europe. The aircraft possessed excellent high-speed manoeuvrability and had outstanding dive and climb characteristics. Many finished their service lives on either side of the Eastern front during World War II.

FRANCE

Blériot-SPAD 510

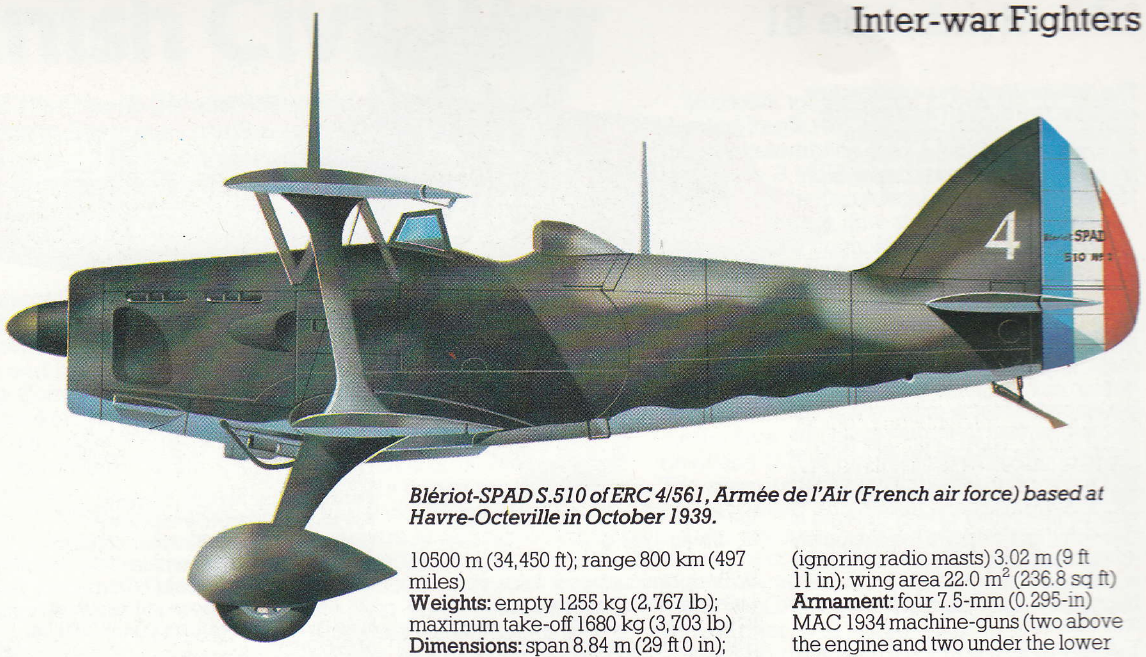
Developed to meet an official French fighter requirement of 1930, the **Blériot-SPAD 510** was the last French fighter biplane, and could trace its ancestry straight back to the famed SPAD scouts of World War I. It differed from them not so much in size, for it was amazingly small, but in having a much more powerful Hispano-Suiza engine in the front of an all-metal fuselage, the rear part being a duralumin monocoque. The equal-span wings had I-type interplane struts and four ailerons, the upper wing alone having pronounced sweepback to bring the centre section well ahead of the pilot. Old technology was seen in the fabric-covered wings, flat frontal radiator and fixed-pitch wooden propeller.

Outclassed by the Dewoitine monoplanes, which in fact were developed more quickly and flew more than six months ahead of the 510's first flight in January 1933, the S.510 was nevertheless agile, a fast climber and quite impressive when expertly flown. As a result it gained a small consolation order



The Blériot-SPAD S.510 was outclassed in acceptance trials by the Dewoitine monoplanes but proved to be an agile, tough and fast-climbing fighter, which continued to see limited service until the war, when it was relegated to second-line duties.

for 60, the last two having the HS 12Xcrs engine with a 20-mm *moteur canon* firing through the propeller hub, this replacing the two fuselage guns though the guns in the wings were retained. Pilots learned to fly the S.510 with abandon, its only real fault being fuel starvation in steep climbs. Landings, however, had to be well-judged since the spatted gears were weak. The puny force served with at least 10 different Armée de l'Air units, which were first-line fighter *escadrilles* (squadrons) in 1937 and second-line regional squadrons from late 1938; by 1940 survivors had been relegated to North Africa.



Blériot-SPAD S.510 of ERC 4/561, Armée de l'Air (French air force) based at Havre-Octeville in October 1939.

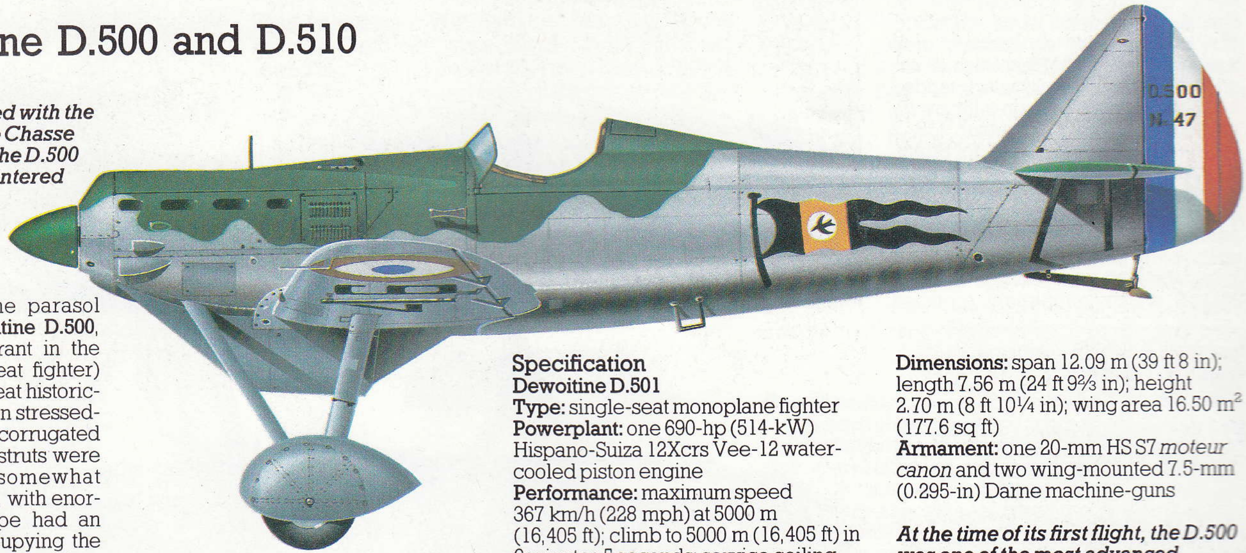
Specification

Blériot-SPAD 510
Type: single-seat biplane fighter
Powerplant: one 690-hp (515-kW) Hispano-Suiza 12Xbrs Vee-12 water-cooled piston engine
Performance: maximum speed 380 km/h (236 mph) at 5000 m (16,405 ft); climb to 4000 m (13,125 ft) in 4 minutes 45 seconds; service ceiling 10500 m (34,450 ft); range 800 km (497 miles)
Weights: empty 1255 kg (2,767 lb); maximum take-off 1680 kg (3,703 lb)
Dimensions: span 8.84 m (29 ft 0 in); length 7.10 m (23 ft 3¾ in); height (ignoring radio masts) 3.02 m (9 ft 11 in); wing area 22.0 m^2 (236.8 sq ft)
Armament: four 7.5-mm (0.295-in) MAC 1934 machine-guns (two above the engine and two under the lower wings)

FRANCE

Dewoitine D.500 and D.510

This Dewoitine D.500 served with the 1ère Escadrille, Groupe de Chasse I/4 at Reims in early 1937. The D.500 first flew in June 1932 and entered service in mid-1935.



Dewoitine abandoned the parasol configuration in the **Dewoitine D.500**, created as an official entrant in the French 1930 C.1 (single-seat fighter) competition. A design of great historical significance, it was a clean stressed-skin monoplane with non-corrugated skin, and the only bracing struts were around the large and somewhat clumsy fixed landing gears, with enormous spats. The prototype had an open cockpit, ailerons occupying the entire trailing edge of the wings (except for small gaps left inboard to permit some downward view) and a huge water-cooling radiator under the engine. First flown on 18 June 1932, by famed company pilot Marcel Doret, the D.500 swept all before it and was easily the best of the prototypes submitted.

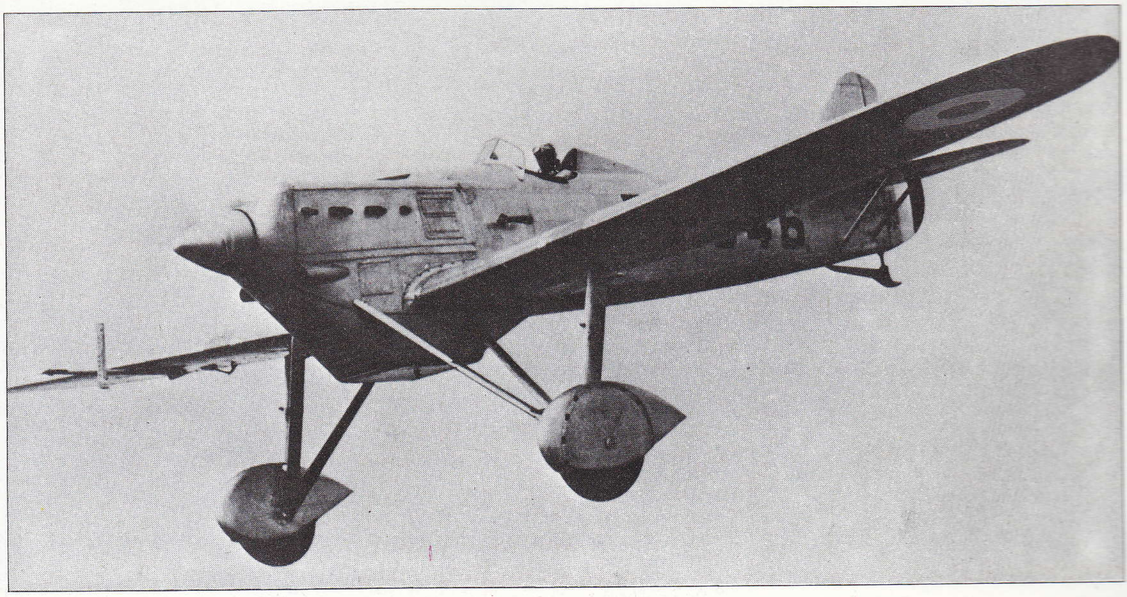
From it stemmed more than 25 different sub-species leading up to the D.520, which was judged the best French fighter of World War II. The initial production D.500 was armed with four 7.5-mm (0.295-in) Darne or MAC 1934 guns, two of them in the wings; other weapons included Colt-Browning in three calibres, the 7.7-mm (0.303-in) Vickers, the 23-mm Madsen and other guns of European origin. Most important was the 20-mm Oerlikon HS S7 cannon mounted between the engine cylinder blocks to fire through the propeller hub. This *moteur canon* was adopted for production, the fighter being redesignated **D.501**, of which l'Armée de l'Air received 133, compared with 100 D.500s.

In 1934 the **D.510** flew with the 860-hp (641-kW) HS 12Ycrs, with more fuel and revised landing gear, and 118 were built (bringing total output of this series to 398 excluding prototypes). Many countries, including the UK, bought examples to see how a modern fighter should be designed.

Specification

Dewoitine D.501
Type: single-seat monoplane fighter
Powerplant: one 690-hp (514-kW) Hispano-Suiza 12Xcrs Vee-12 water-cooled piston engine
Performance: maximum speed 367 km/h (228 mph) at 5000 m (16,405 ft); climb to 5000 m (16,405 ft) in 6 minutes 5 seconds; service ceiling 10790 m (35,400 ft); range 870 km (540 miles)
Weights: empty 1287 kg (2,837 lb); maximum take-off 1787 kg (3,940 lb)
Dimensions: span 12.09 m (39 ft 8 in); length 7.56 m (24 ft 9⅔ in); height 2.70 m (8 ft 10¼ in); wing area 16.50 m^2 (177.6 sq ft)
Armament: one 20-mm HS S7 *moteur canon* and two wing-mounted 7.5-mm (0.295-in) Darne machine-guns

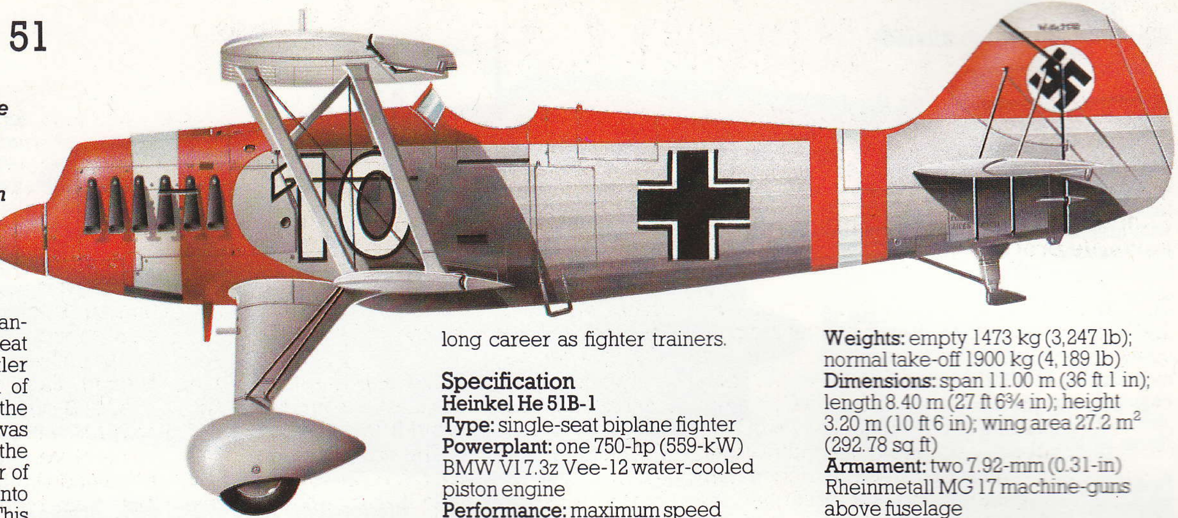
At the time of its first flight, the D.500 was one of the most advanced aircraft in the world, and it inspired many later fighters. At the heart of its success was the flush-riveted metal skinning.



GERMANY

Heinkel He 51

The Heinkel He 51 was an attractive and effective aircraft with a sturdy structure. This example was an He 51B-1 serving with 2. Staffel, Jagdgeschwader 132 at Döberitz in 1937.



Ernst Heinkel Flugzeugwerke managed to produce a succession of neat biplane fighters long before Hitler came to power, and the addition of Walter and Siegfried Günther to the design staff added a grace which was evident in their first design for the company, the **Heinkel He 49** fighter of November 1932. They refined this into the **He 51** in the summer of 1933. This was the first fighter openly ordered in Germany, and it formed the equipment of the first intensely proud fighter squadrons of the Luftwaffe, over 800 being built by Heinkel, Arado, Erla and Fieseler.

A substantial machine of traditional form, the He 51 was notable in the completeness and excellence of its equipment, though the structure was the familiar mix of metal, wood and fabric. The **He 51B-1** had an auxiliary drop tank and the final 100 Fieseler-built aircraft were **He 51C** machines intended for close-support in Spain with six 10-kg (22-lb) bombs. Altogether 135 of various types were sent to Spain, where it was soon found that they were unable to manoeuvre as well as the Soviet Polikarpov I-15, and also had poorer speed and climb. This was a major blow to Heinkel, who was also losing the next generation to Messerschmitt which completely replaced the He 51 in Luftwaffe *Jagdgeschwader* during 1937-8.

Surviving He 51s served with the Spanish Nationalist air force and with Luftwaffe training schools, while 45 He 51Bs were completed as **He 51B-2** twin-float seaplanes which had quite a long career as fighter trainers.

Specification
Heinkel He 51B-1

Type: single-seat biplane fighter
Powerplant: one 750-hp (559-kW) BMW VI 7.3z Vee-12 water-cooled piston engine
Performance: maximum speed 330 km/h (205 mph) at sea level (slower at higher altitudes); climb to 2000 m (6,560 ft) in 3 minutes 5 seconds; service ceiling 7700 m (25,260 ft); range (economy cruise at 6000 m/19,685 ft with drop tank) 700 km (435 miles)
Weights: empty 1473 kg (3,247 lb); normal take-off 1900 kg (4,189 lb)
Dimensions: span 11.00 m (36 ft 1 in); length 8.40 m (27 ft 6¾ in); height 3.20 m (10 ft 6 in); wing area 27.2 m^2 (292.78 sq ft)
Armament: two 7.92-mm (0.31-in) Rheinmetall MG 17 machine-guns above fuselage

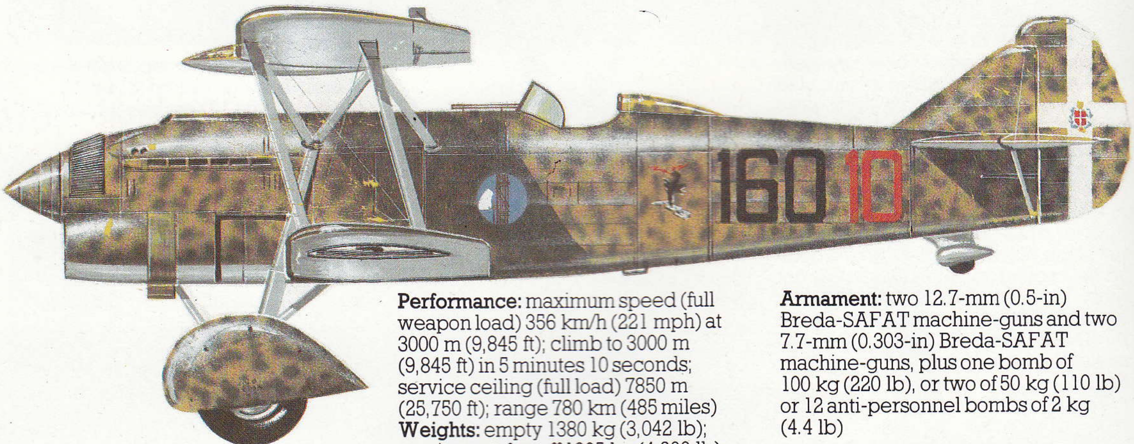
The first German fighter to fire its guns in anger since the end of World War I, the Heinkel He 51 saw much service in the Spanish Civil War, where it was outclassed by the Republicans' Polikarpovs.

ITALY

Fiat C.R.32

The first standard fighter of Italian design to go into production after World War I was the **Fiat C.R.1** of 1923, C.R. standing for Caccia Rosatelli (fighter designed by Celestino Rosatelli). Its only unusual feature was the arrangement of the interplane struts, of the zig-zag Warren-truss type. This was the start of a famous C.R. series which, in relation to their contemporaries, reached their zenith with the **C.R.30** of 1932 and the **C.R.32** of 1933. While engines got more powerful, Rosatelli fought to keep his fighters small and light, and the C.R.32 was one of the smallest and most agile fighters of its day. Moreover, as the two guns were in most versions of the 0.5-in (12.7-mm) size the Fiats had far more punch than most of their opponents. The **C.R.32bis** had an additional pair of 7.7-mm (0.303-in) guns mounted above the lower wings, and could also carry bombs (see specification).

Throughout the 1930s the C.R.30 and C.R.32 were flamboyantly demonstrated by the Regia Aeronautica, in aerobatic displays, races and flying meetings of all kinds, gaining great success and many export orders. The C.R.32 in four main variants (including the **C.R.32ter** with revised landing gear and **C.R.32quater** improved C.R.32ter) was the more numerous model, 1,212 being built by 1939. Of these at least 380 fought in Spain, proving the most dangerous fighter deployed by the Nationalists until the arrival of the Bf 109. Spain also built the type under licence in 1938-42 as the **Hispano HA-132-L**. Even when Italy entered World War II in 1940 at least 400 C.R.32s were in front-line *squadriglie* (squadrons), though despite their manoeuvrability they had a hard time in day air combat, soon being relegated to close-support and night activities.

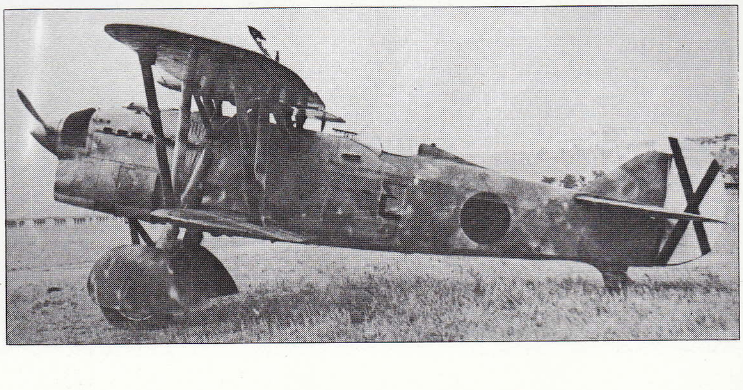


This Fiat C.R.32quater flew with 160ª Squadriglia, 12° Gruppo, 50° Stormo at Tobruk in October 1940.

Specification
Fiat C.R.32bis

Type: single-seat fighter-bomber
Powerplant: one 600-hp (447-kW) Fiat A.30 RAbis Vee-12 water-cooled piston engine
Performance: maximum speed (full weapon load) 356 km/h (221 mph) at 3000 m (9,845 ft); climb to 3000 m (9,845 ft) in 5 minutes 10 seconds; service ceiling (full load) 7850 m (25,750 ft); range 780 km (485 miles)
Weights: empty 1380 kg (3,042 lb); maximum take-off 1905 kg (4,200 lb)
Dimensions: span 9.50 m (31 ft 2 in); length 7.45 m (24 ft 5¼ in); height 2.72 m (8 ft 11 in); wing area 22.1 m^2 (237.89 sq ft)
Armament: two 12.7-mm (0.5-in) Breda-SAFAT machine-guns and two 7.7-mm (0.303-in) Breda-SAFAT machine-guns, plus one bomb of 100 kg (220 lb), or two of 50 kg (110 lb) or 12 anti-personnel bombs of 2 kg (4.4 lb)

Among the best fighters of all time, the Fiat C.R.32 possessed all the attributes of its genre: speed, agility, climb performance and strength.



The Spanish Civil War

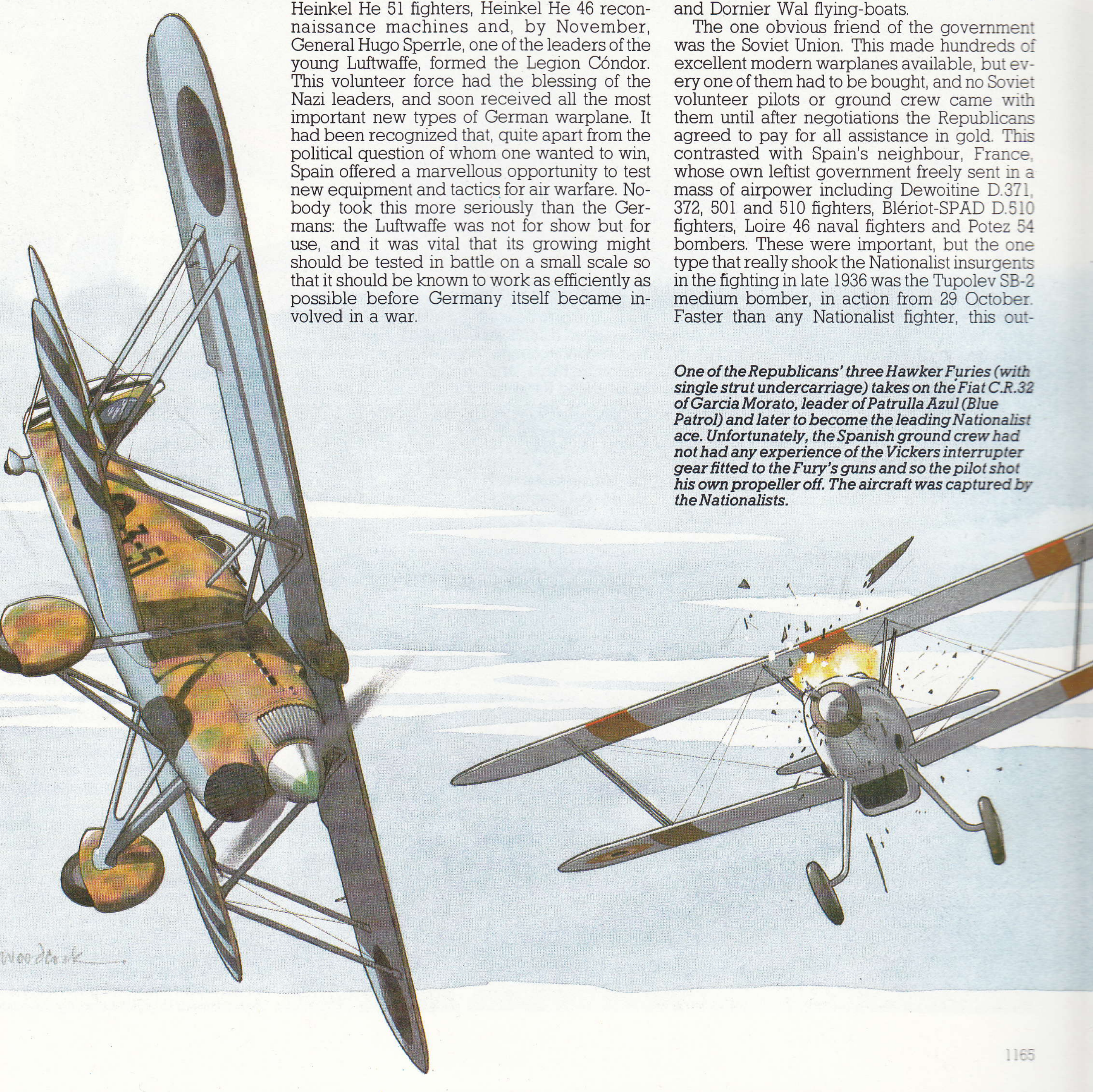
The tragedy of the Spanish Civil War needs little introduction, with the bitter struggle foreshadowing the greater European conflict to come. The ferocity of the war was not eased by the decision of other countries to involve themselves directly, supplying weapons and troops and prolonging the agony of the Spanish people. Their interest was far from altruistic, for the Spanish landscape was to become a valuable proving-ground for new weapons and tactics.

The most tragic and sustained human conflict of this century has revolved around what are politically called the Left and Right. Nowhere has this conflict reached such violence and bitterness as in Spain, where the basically Communist (left) government in 1936 provoked increasingly strong reaction from the ultra-right, which included most of the senior officers and what might be called 'official establishment'. By 18 July 1936 the scattered warfare erupted into full-scale rebellion; in every military unit there was violence, most of the junior officers and other ranks remaining loyal to what became called the Republicans. Senior officers, and many career fighter pilots, strongly supported the insurrection, joining what became the Nationalist cause.

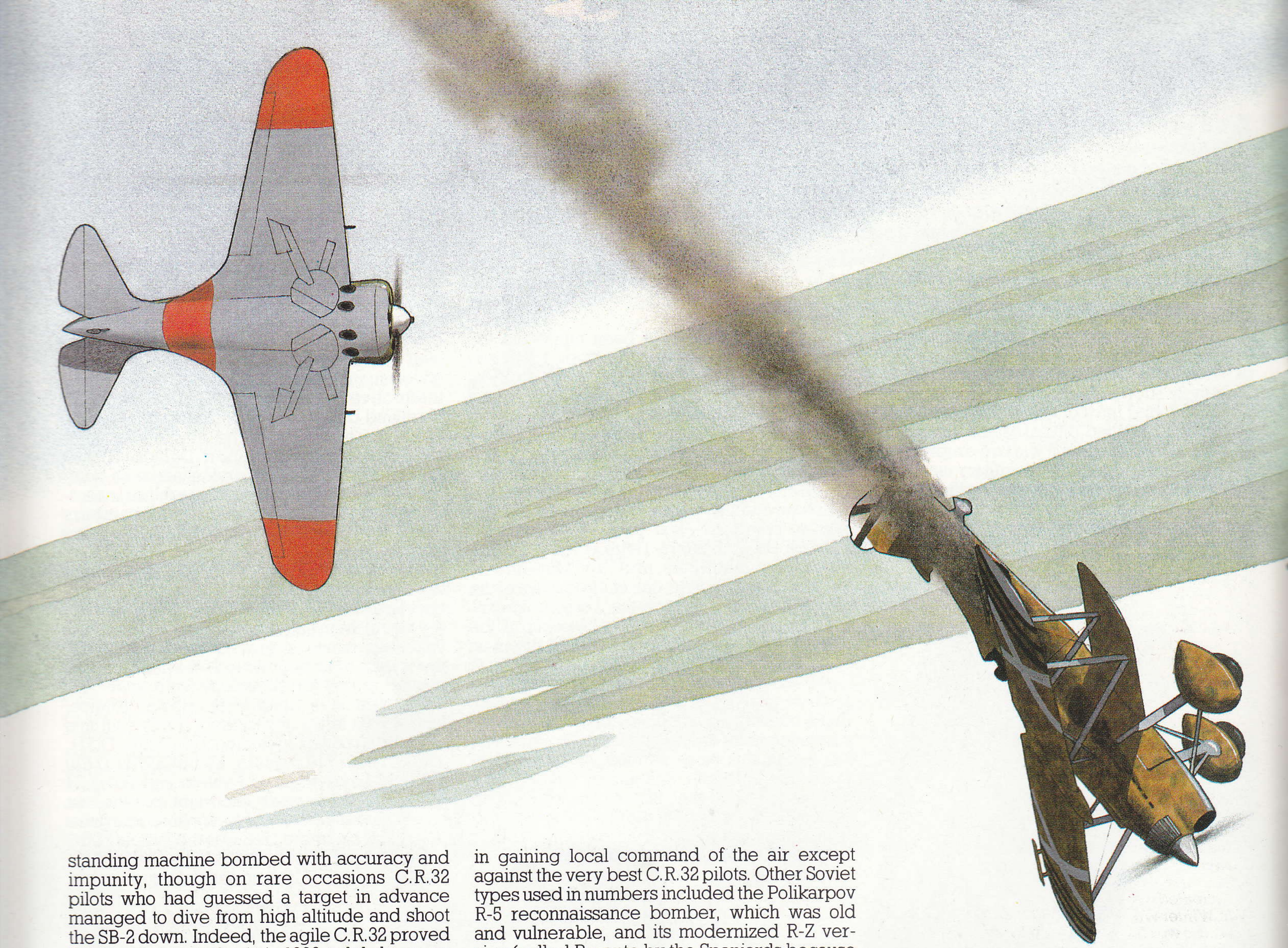
The latter might have been nipped in the bud had not a capable army officer, Francisco Franco, managed to airlift the tough Army of Africa from Morocco. This gained control in the south, while Fascist friends of the Nationalists in Rome and Berlin swiftly began sending in war supplies, most notably including air forces. Hitler sent a dozen Junkers Ju 52/3mg3e bomber transports which played a central role in the Morocco airlift and subsequently went into action as bombers. Next came a squadron of Heinkel He 51 fighters, Heinkel He 46 reconnaissance machines and, by November, General Hugo Sperrle, one of the leaders of the young Luftwaffe, formed the Legion Cóndor. This volunteer force had the blessing of the Nazi leaders, and soon received all the most important new types of German warplane. It had been recognized that, quite apart from the political question of whom one wanted to win, Spain offered a marvellous opportunity to test new equipment and tactics for air warfare. Nobody took this more seriously than the Germans: the Luftwaffe was not for show but for use, and it was vital that its growing might should be tested in battle on a small scale so that it should be known to work as efficiently as possible before Germany itself became involved in a war.

Mussolini too was glad to send in his much-vaunted Regia Aeronautica, starting with types visually resembling the German ones: Savoia-Marchetti S.M.81 bombers and Fiat C.R.32 fighters. To the Republican government (legitimate, no matter how unpopular) it was outrageous that it might lose the war through Fascist help from outside. It appealed for help, and thousands of leftist volunteers came at their own expense to fight in the International Brigades and with the Republican air force. Many brought their own aircraft, and by late 1936 over 240 different types were serving in the government air force. Almost all were wholly ineffective, ranging from 1918-vintage de Havilland D.H.9s to new American lightplanes. The main types left in the Republican force proper were the Nieuport-Delage NiD.52 fighter, Breguet Bre.XIX reconnaissance bomber and a collection of naval machines including Vickers Vildebeest torpedo bombers (built by CASA with Hispano-Suiza engines) and Dornier Wal flying-boats.

The one obvious friend of the government was the Soviet Union. This made hundreds of excellent modern warplanes available, but every one of them had to be bought, and no Soviet volunteer pilots or ground crew came with them until after negotiations the Republicans agreed to pay for all assistance in gold. This contrasted with Spain's neighbour, France, whose own leftist government freely sent in a mass of airpower including Dewoitine D.371, 372, 501 and 510 fighters, Blériot-SPAD D.510 fighters, Loire 46 naval fighters and Potez 54 bombers. These were important, but the one type that really shook the Nationalist insurgents in the fighting in late 1936 was the Tupolev SB-2 medium bomber, in action from 29 October. Faster than any Nationalist fighter, this out-



One of the Republicans' three Hawker Furies (with single strut undercarriage) takes on the Fiat C.R.32 of Garcia Morato, leader of Patrulla Azul (Blue Patrol) and later to become the leading Nationalist ace. Unfortunately, the Spanish ground crew had not had any experience of the Vickers interrupter gear fitted to the Fury's guns and so the pilot shot his own propeller off. The aircraft was captured by the Nationalists.



standing machine bombed with accuracy and impunity, though on rare occasions C.R.32 pilots who had guessed a target in advance managed to dive from high altitude and shoot the SB-2 down. Indeed, the agile C.R.32 proved the best fighter in Spain in 1936, solely because of its unequalled power of manoeuvre when well flown.

Like the massive ground battles, the air was a ding-dong slugging match. By November 1936 the Soviet Union had sent Polikarpov I-15 and I-16 fighters, and these usually succeeded in gaining local command of the air except against the very best C.R.32 pilots. Other Soviet types used in numbers included the Polikarpov R-5 reconnaissance bomber, which was old and vulnerable, and its modernized R-Z version (called Razante by the Spaniards because of the way they shaved the ground on operations). By spring 1937 the Legion Cóndor was being built up by massive deliveries of much newer and better types. Most important were the Messerschmitt Bf 109B fighter and Heinkel He 111B-1 bomber, though other new equipment included the Dornier Do 17F and Henschel Hs 123.

During the fighting around Madrid in late 1936 the Ju 52s of Kampfgruppe 88 had suffered severely and been driven to night bombing. The commander, Oberleutnant Freiherr von Moreau, went to Berlin and returned in 1937 with the new Heinkels. These swept all before them, except for the speedy Moscas (Republican name for the I-16) which could not only shoot down the new bomber but also often beat the formidable new Messerschmitts. Such interceptions were rare, and K88 built up its strength to over 50 Heinkels which mounted increasingly devastating attacks on Republican airfields and other targets. Ironically, it was the widely publicized bombing of the town of Guernica on 26 April 1937 that gave the Heinkel a bad name around the world, whereas there is no certainty that any He 111s took part! There is bitter argument to this day on who served as pathfinder, but no doubt that the main weight of bombs fell from Ju 52s.

Throughout 1937 and the following year the world's newspapers reported strange deals involving anything from one to more than 40 aircraft which, ostensibly being exported to more

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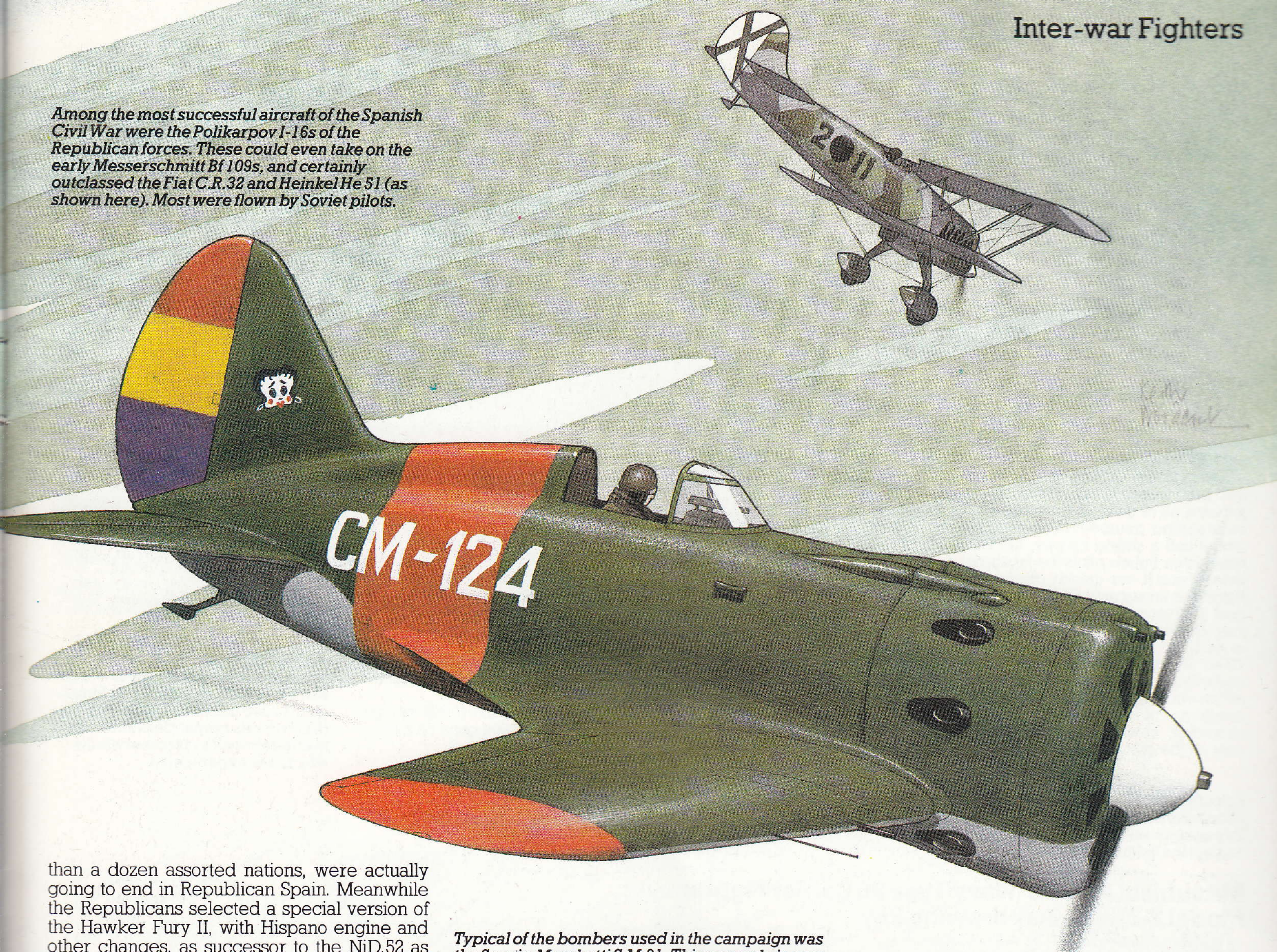
The Spanish Civil War provided the baptism of fire for many types which were to be used by the Luftwaffe in World War II. Among the most important of these was the Messerschmitt Bf 109, a squadron of Bf 109E-1s being seen here.

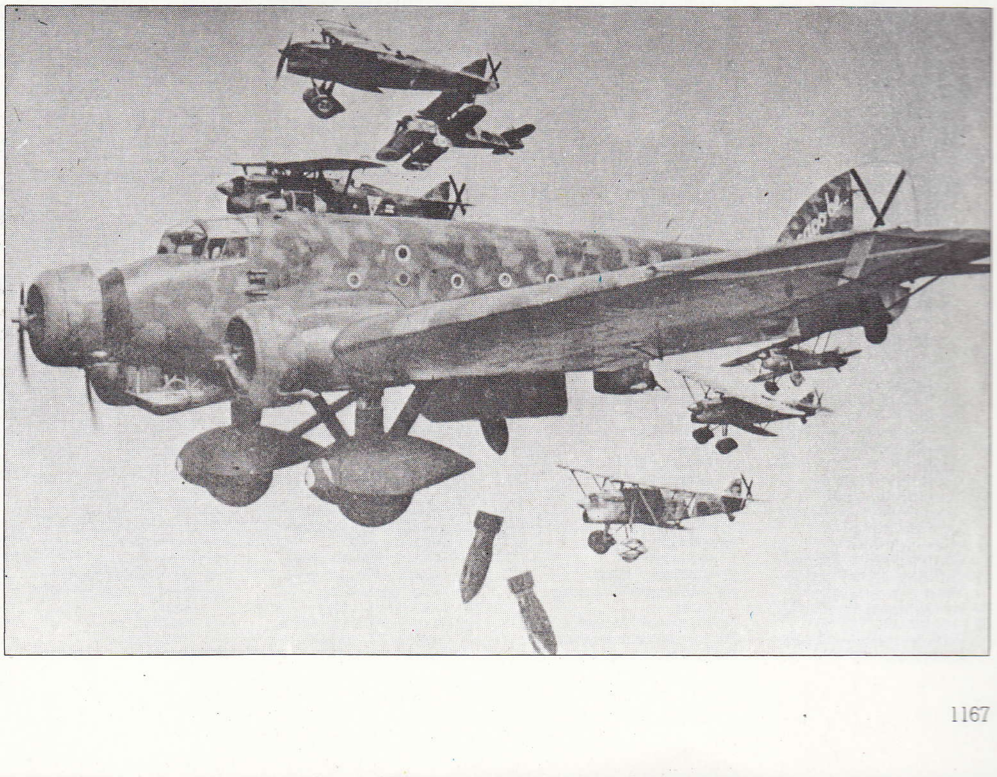


Among the most successful aircraft of the Spanish Civil War were the Polikarpov I-16s of the Republican forces. These could even take on the early Messerschmitt Bf 109s, and certainly outclassed the Fiat C.R.32 and Heinkel He 51 (as shown here). Most were flown by Soviet pilots.

than a dozen assorted nations, were actually going to end in Republican Spain. Meanwhile the Republicans selected a special version of the Hawker Fury II, with Hispano engine and other changes, as successor to the NiD.52 as official fighter. Three were supplied from Kingston, and did brilliantly, but plans for Spanish production came to nothing. Meanwhile the influx of Fascist aircraft and crews swelled, with Fiat B.R.20s and G.50s, Breda 65s, Savoia-Marchetti S.M.79s, Caproni 310s, Junkers Ju 86s, Junkers Ju 87s, Henschel Hs 126 army co-operation aircraft, Heinkel He 112 fighters, Arado Ar 95 seaplanes and, not least, the overwhelmingly formidable Bf 109E all getting into action as the bloody war drew to its inevitable conclusion with the entry to Madrid and final Republican defeat on 28 March 1939.

While the Soviet Union had supplied roughly 500 SB-2s and at least 1,000 Polikarpov fighters, it gained nothing but gold. Its often wildly wrong operational tactics were never tested or altered and were still being used when Germany invaded in June 1941. In contrast Hitler's Luftwaffe gained incalculable experience not only in proving its new warplanes but also in their operational deployment. Many of their bomber crews had flown over 100 combat missions, and their fighter pilots had passed through the dangerous period of inexperience and become mature and deadly opponents. In only one respect did the Spanish civil war give a misleading indication: the Luftwaffe went on equipping with fast but lightly armed bombers whose ability to survive in daylight was to be rudely exposed as a myth in the Battle of Britain.

Typical of the bombers used in the campaign was the Savoia-Marchetti S.M.81. This example is seen on the point of bomb-release whilst escorted by Fiat C.R.32s performing their well-known weaving manoeuvres, whereby every aircraft covered another at any time.

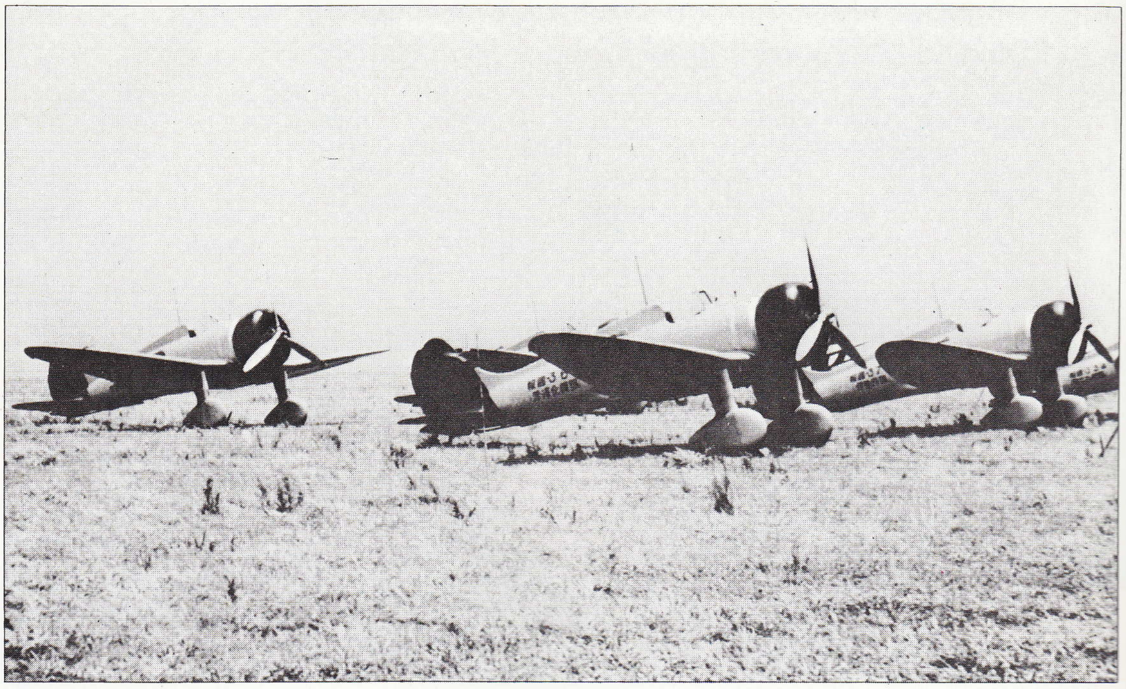


JAPAN

Mitsubishi A5M

The **Mitsubishi A5M** was a landmark in fighter design, and especially for the Japanese aircraft industry. Designed under the leadership of Jiro Horikoshi, who later was to be regarded almost as a national saviour because of the next-generation A6M (Zero), the A5M was the first Japanese aircraft to beat all the competition. Though it had to meet a challenging requirement of the Imperial Japanese Navy for a carrier-based fighter, it was amazingly clean, despite having fixed landing gear, and its features included an excellently cowled engine, large fuel capacity in four wing tanks and a drop tank, flaps, provision for various external weapon loads and, not least, an extremely strong flush-riveted stressed-skin structure. The prototype flew in February 1935 (and the British Fleet Air Arm did not get a fabric-covered Hawker Sea Hurricane until six years later).

Subsequently Mitsubishi delivered 982 production A5Ms in four major variants, all of them characterized by outstanding manoeuvrability. One model had a sliding canopy, but like many other fighter pilots the Japanese hated it and it was quickly discarded. Battle was joined over China on 22 August 1937 as related elsewhere, and very few opponents ever succeeded in bringing their guns to bear on an A5M. Standard equipment included night-flying lighting, radio, oxygen, above-wing formation lights, catapult spools and arrester hook. The usual propeller, however, was adjustable only on the ground.



An amazingly clean aircraft for its day, the Mitsubishi A5M led the world in carrierborne fighter design before the war, as well as teaching its land-based cousins a thing or two. At the root of its tremendous success was the aircraft's manoeuvrability, which was unparalleled.

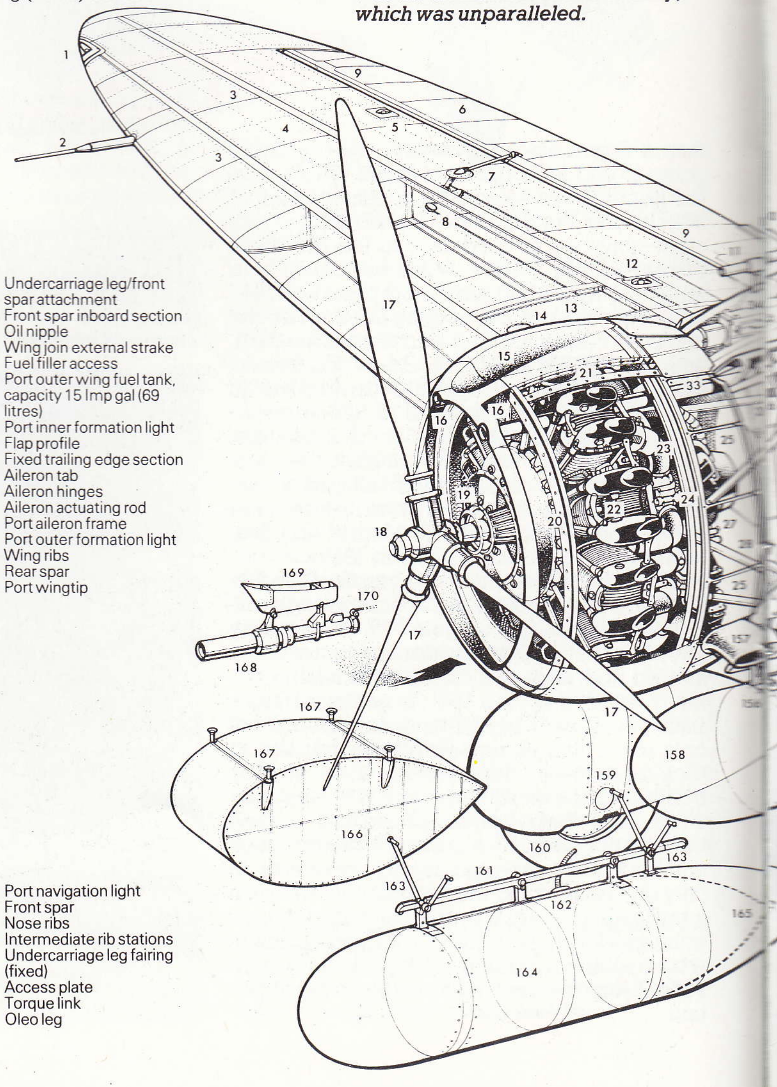
Specification
Mitsubishi A5M4
Type: single-seat carrier-based monoplane fighter-bomber

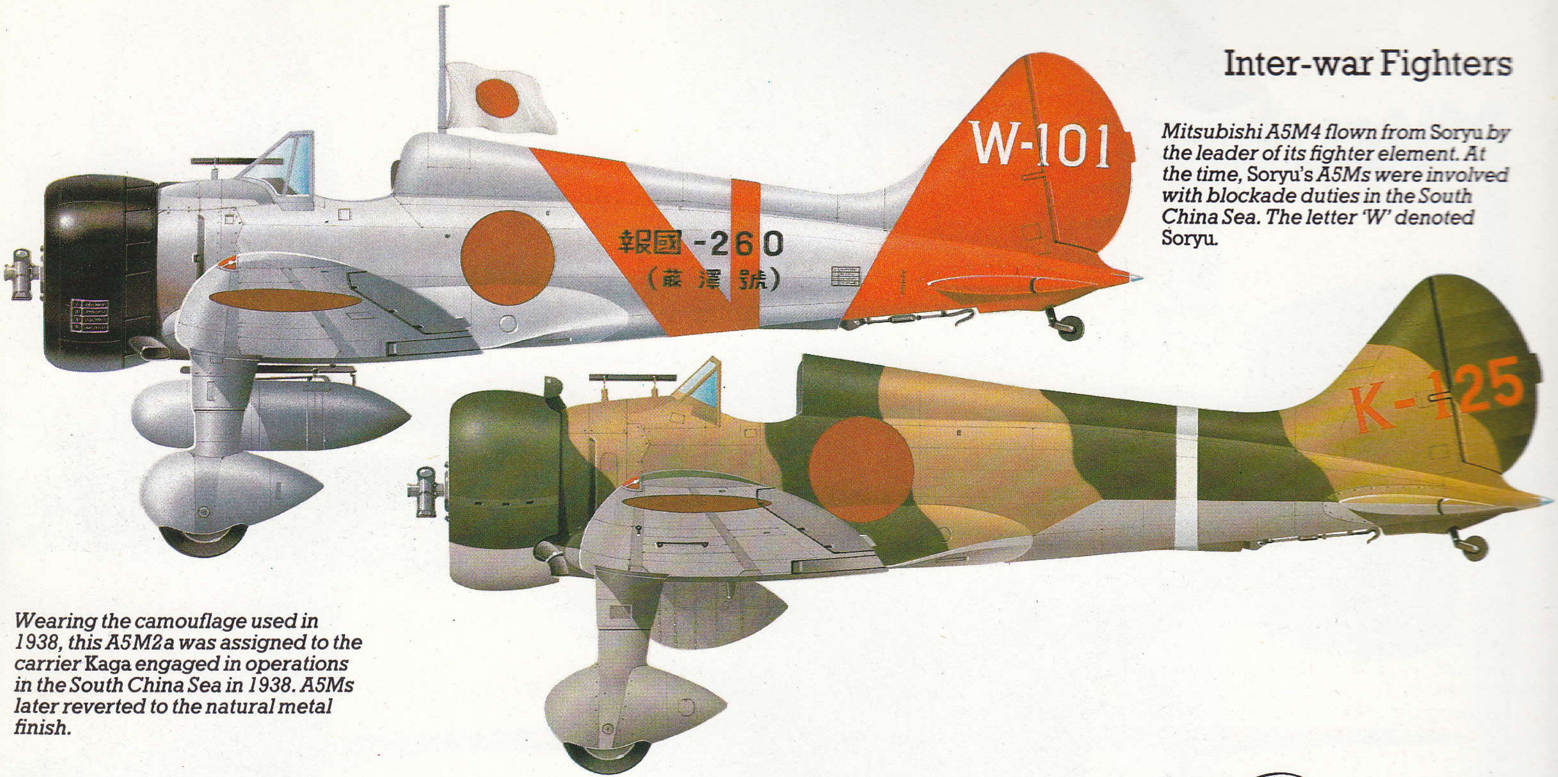
Powerplant: one 785-hp (585-kW) Nakajima Kotobuki (licensed Jupiter) Model 41 nine-cylinder air-cooled radial piston engine
Performance: maximum speed 434 km/h (270 mph) at 3000 m (9,845 ft); climb to 3000 m (9,845 ft) in 3 minutes 35 seconds; service ceiling 9800 m (32,150 ft); range (with smaller-size 160-litre/35-Imp gal drop tank) 1200 km (746 miles)
Weights: empty 1216 kg (2,681 lb); maximum take-off 1707 kg (3,763 lb)

Dimensions: span 11.00 m (36 ft 10.7 in); length 7.56 m (24 ft 9⅔ in); height 3.27 m (10 ft 8¾ in); wing area 17.8 m^2 (191.6 sq ft)
Armament: two 7.7-mm (0.303-in) type 89 (Vickers) machine-guns, plus two 30-kg (66-lb) bombs

Mitsubishi A5M2b (Navy Type 96 Carrier Fighter Model 2-2) cutaway drawing key

1 Starboard navigation light
2 Pitot head
3 Wing spar stations
4 Wing skinning
5 Starboard outer formation light
6 Starboard aileron
7 Aileron actuating rod
8 Control linkage
9 Aileron hinges
10 Aileron tab
11 Type 89-1 tubular gunsight (offset to starboard)
12 Starboard inner formation light
13 Starboard outer wing fuel tank, capacity 15 Imp gal (69 litres)
14 Fuel filler access
15 Cowling (downward visibility) cut-out
16 Machine gun ports
17 Three-blade SS-22 two-pitch propeller
18 Propeller hub
19 Propeller shaft gear
20 Cowling forward ring
21 Panel fasteners
22 Nakajima Kotobuki 3 nine-cylinder radial engine
23 Exhaust pipes
24 Cowling frame
25 Cooling gills
26 Engine bearer upper supports
27 Engine accessories
28 Engine bearer lower supports
29 Ammunition magazines
30 Exhaust/cooling slot
31 Engine support/bulkhead upper attachment
32 Ammunition feed
33 Machine gun barrel sleeve
34 Starboard 7.7-mm Type 89 (Vickers) machine-gun
35 Windscreen frames
36 Flat panels
37 Port machine gun charging mechanism
38 Fuselage forward mainframe (No.1)
39 Fishtail external plating
40 Control column
41 Rudder pedal bar assembly
42 Cartridge ejection chute
43 Fuselage frame/front spar attachment
44 Fuel filler access
45 Control cables
46 Type 96-I radio control box
47 Radio receiver (port)
48 Radio transmitter (starboard)
49 Oxygen control unit
50 Arrester hook retraction control
51 Distribution panel
52 Cockpit fixed coaming
53 Radio connector box
54 Fuselage mainframe (No.2)
55 Pilot's seat
56 Arrester hook release lever
57 Seat adjustment lever
58 Fuselage frame/rear spar attachment
59 Dynamotor
60 Battery installation
61 Oxygen cylinder
62 Electrical leads
63 Strengthened pick-up point
64 Fuselage upper longeron
65 Pilot's headrest
66 Turn-over frame fairing
67 Aerial lead-in
68 Aerial mast
69 Aerial
70 Dorsal spine
71 Spine former frames
72 Fuselage skinning
73 Access point
74 Fuselage frames
75 Abbreviated centre longeron
76 Wingroot fairings
77 Arrester hook release cable
78 Rudder control cables
79 Elevator control cables
80 Fuselage structure
81 Turnbuckles
82 Strengthened fuselage frame (No.10)
83 Arrester hook retraction cable
84 Tailfin root fairing frames
85 Starboard tailplane
86 Starboard elevator
87 Tailfin root/spine fairing
88 Tailfin front spar
89 Tailfin structure
90 Leading-edge structure
91 Aerial attachment
92 Rudder hinges
93 Rudder frame
94 Rudder tab
95 Rudder actuating hinge fairing
96 Angled rudder post
97 Tailwheel oleo access plate
98 Rudder control linkage
99 Tail navigation light
100 Elevator tab
101 Elevator frame
102 Tailplane structure
103 Non-retractable tailwheel
104 Tailwheel leg fairing
105 Elevator torque tube
106 Fuselage aft frame
107 Arrester hook retraction cable guide
108 Fuselage frame/tailplane spar attachment
109 Centre brace
110 Arrester hook internal strut
111 Arrester hook (retracted)
112 Hook travel
113 Arrester hook (extended)
114 Pivot point
115 Release mechanism
116 Ventral strengthening
117 Wingroot fillet
118 Retractable entry step
119 Wingroot fairing frames
120 Wing flap section
121 Non-slip entry step
122 Port inner wing fuel tank, capacity 23 Imp gal (104 litres)
123 Undercarriage leg/front spar attachment
124 Front spar inboard section
125 Oil nipple
126 Wing join external strake
127 Fuel filler access
128 Port outer wing fuel tank, capacity 15 Imp gal (69 litres)
129 Port inner formation light
130 Flap profile
131 Fixed trailing edge section
132 Aileron tab
133 Aileron hinges
134 Aileron actuating rod
135 Port aileron frame
136 Port outer formation light
137 Wing ribs
138 Rear spar
139 Port wingtip
140 Port navigation light
141 Front spar
142 Nose ribs
143 Intermediate rib stations
144 Undercarriage leg fairing (fixed)
145 Access plate
146 Torque link
147 Oleo leg

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(蔵 澤 號)
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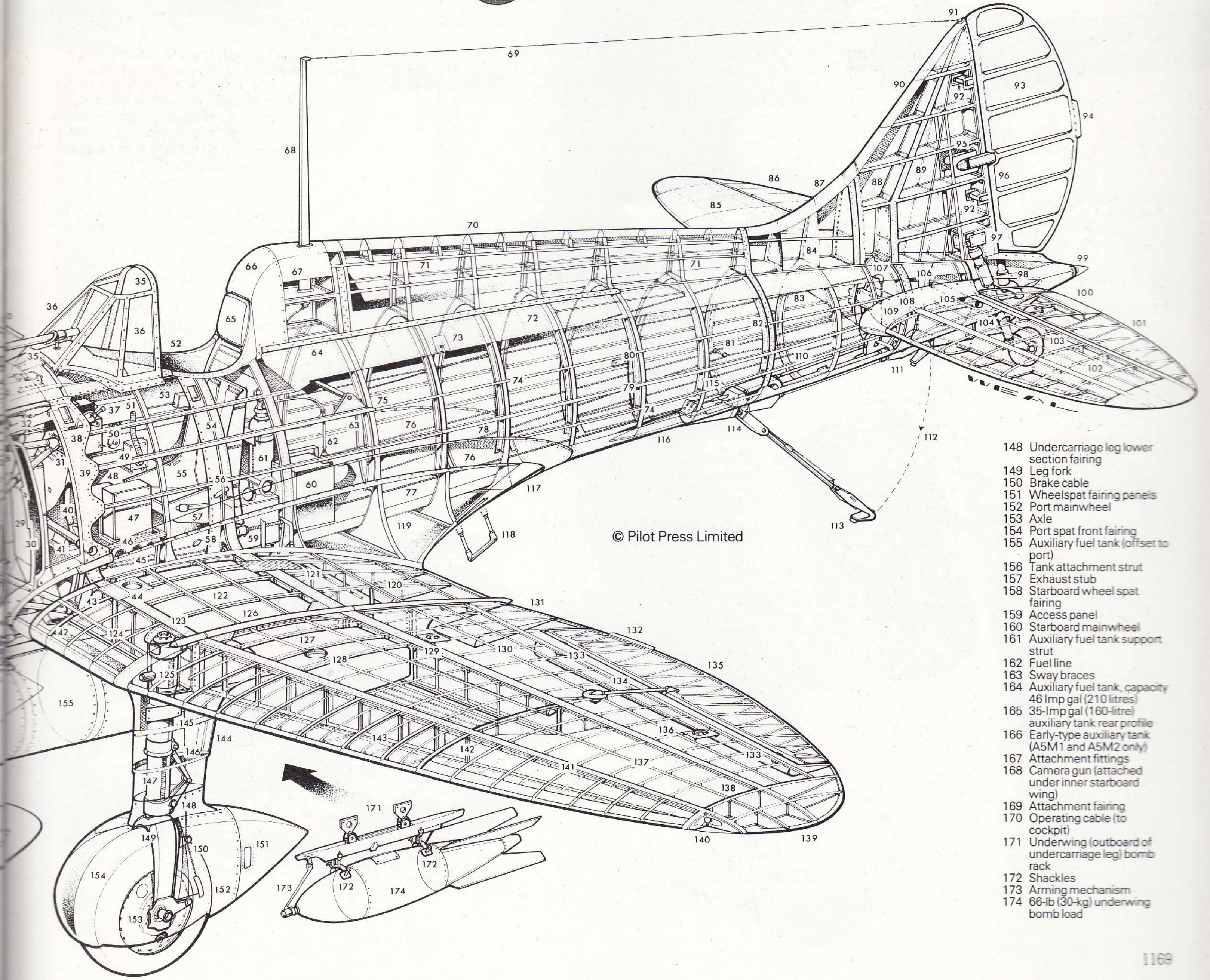
Mitsubishi A5M4 flown from Soryu by the leader of its fighter element. At the time, Soryu's A5Ms were involved with blockade duties in the South China Sea. The letter 'W' denoted Soryu.

Wearing the camouflage used in 1938, this A5M2a was assigned to the carrier Kaga engaged in operations in the South China Sea in 1938. A5Ms later reverted to the natural metal finish.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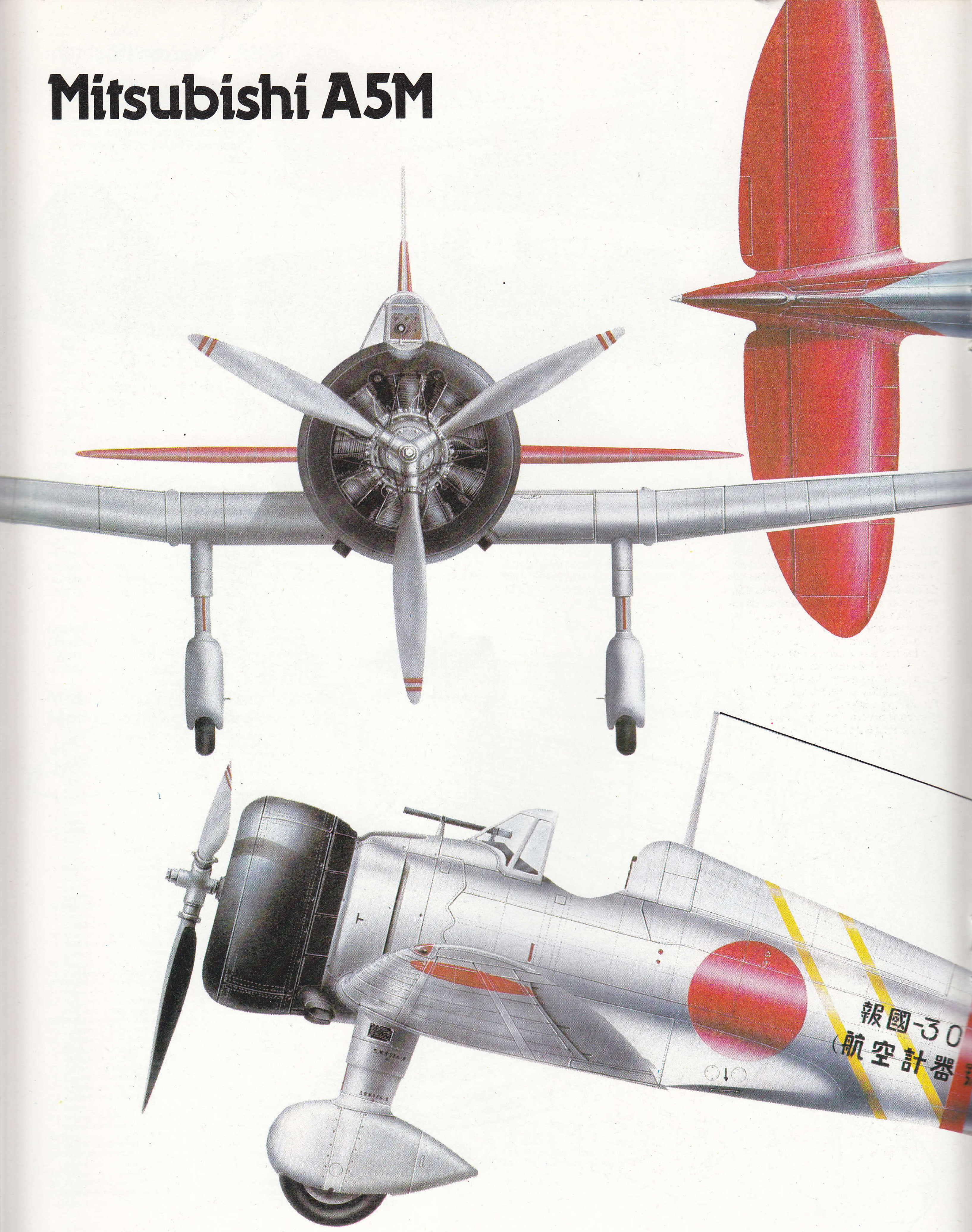
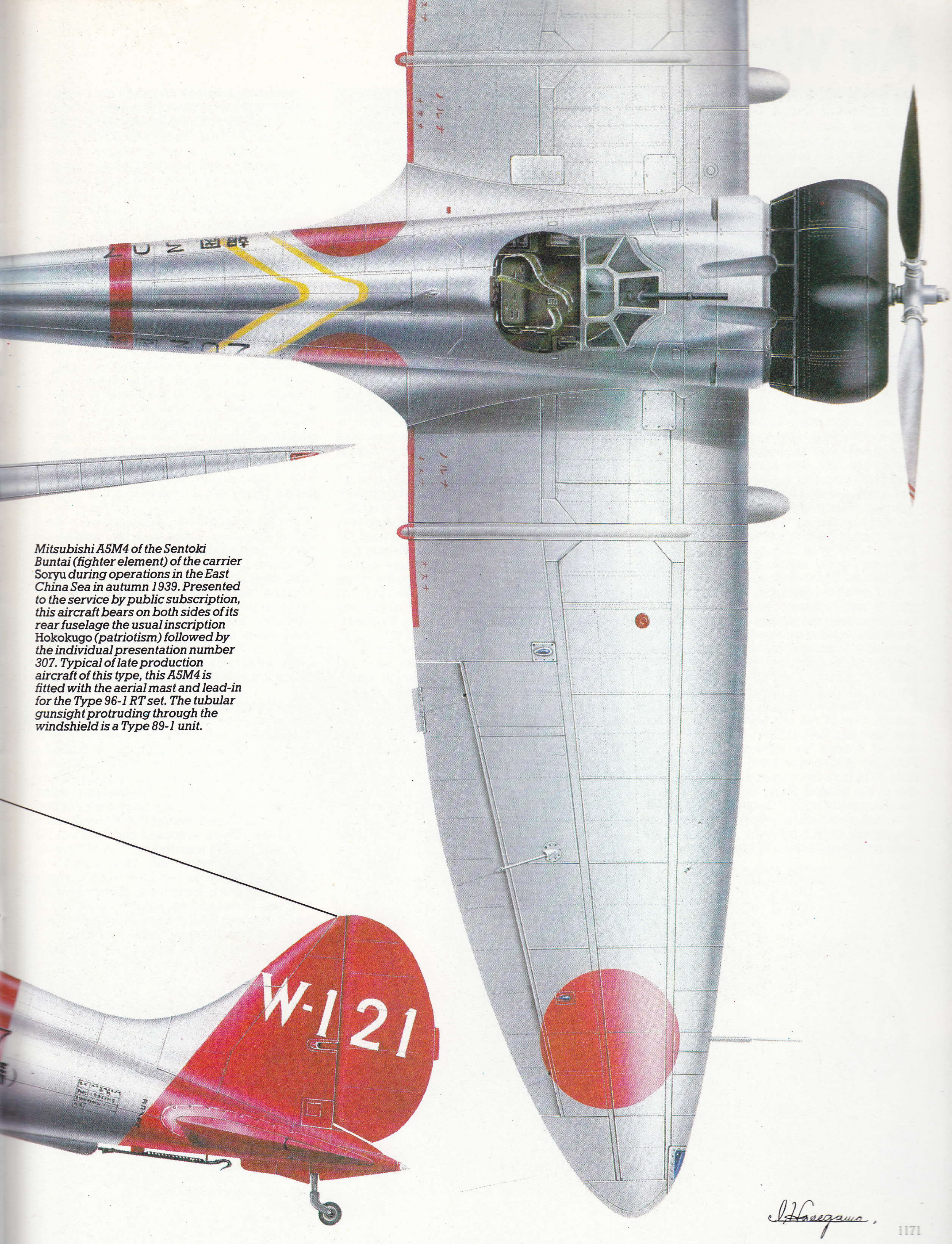
148 Undercarriage leg lower section fairing
149 Leg fork
150 Brake cable
151 Wheelspat fairing panels
152 Port mainwheel
153 Axle
154 Port spat front fairing
155 Auxiliary fuel tank (offset to port)
156 Tank attachment strut
157 Exhaust stub
158 Starboard wheel spat fairing
159 Access panel
160 Starboard mainwheel
161 Auxiliary fuel tank support strut
162 Fuel line
163 Sway braces
164 Auxiliary fuel tank, capacity 46 Imp gal (210 litres)
165 35-Imp gal (160-litre) auxiliary tank rear profile
166 Early-type auxiliary tank (A5M1 and A5M2 only)
167 Attachment fittings
168 Camera gun (attached under inner starboard wing)
169 Attachment fairing
170 Operating cable (to cockpit)
171 Underwing (outboard of undercarriage leg) bomb rack
172 Shackles
173 Arming mechanism
174 66-lb (30-kg) underwing bomb load

Mitsubishi A5M





Mitsubishi A5M4 of the Sentoki Buntai (fighter element) of the carrier Soryu during operations in the East China Sea in autumn 1939. Presented to the service by public subscription, this aircraft bears on both sides of its rear fuselage the usual inscription Hokokugo (patriotism) followed by the individual presentation number 307. Typical of late production aircraft of this type, this A5M4 is fitted with the aerial mast and lead-in for the Type 96-1 RT set. The tubular gunsight protruding through the windshield is a Type 89-1 unit.

I. Hasegawa.

Air War over China

The end of World War I had left Japan the strongest military power in the Far East. The natural direction for the expansion of Japanese influence lay on the Chinese mainland, and the 1920s and early 1930s saw a gradual rise in military intervention in China by the Imperial forces. The annexation of Manchuria was to be followed in 1937 by full-scale war with China, and border clashes with Mongolia were to bring Japan into conflict with the Soviet Union in 1939.

After World War I the Imperial Japanese Army formed an air service under the guidance of French instructors, whilst the Imperial Japanese Navy did the same guided by the British. An aircraft industry was also built up, and by the late 1920s Japan had considerable design capability and well-trained and growing air units. These were eager to flex their muscles, and Japan contrived a succession of 'incidents' to foment local conflicts. A full-scale war was to be avoided during this uncertain phase; the intention was to test Japanese army and navy aircraft and pilots in local combats to see if they could defeat their enemies.

Only about 50 aircraft in all were involved in the brief action which followed the Tsinan Incident in 1928. This gave confidence for a much bigger test, and the Manchurian Incident of September 1931 was followed by such prolonged fighting that it soon became a proper war. It was obvious from the start that, despite colossal manpower, China was almost defenceless in the air, and this played a significant part in Japan's victories on the ground. The upshot was the establishment of a Japanese puppet regime in Manchuria, which was renamed Manchukuo.

Next came the Shanghai Incident of January 1932. It was probably obvious to the Chinese that they were the victims of a succession of stage-managed events whose purpose was eventually to bring about Japanese expansion into the Asian mainland, but no attempt was made to build up a strong Chinese air force. Instead air defence became assigned to a trickle of Western volunteers who came for the money. One of the few who became famous was American Robert Short, who was given the one-off Boeing 218 fighter biplane. On 22 February 1932 he shot down at least one Mitsubishi B1M from the carrier *Kaga* before being shot down himself. Some 50 Japanese aircraft were in action during February in the Shanghai area, half coming from another carrier *Hosho*. Meanwhile larger numbers of army aircraft were on active service in Manchukuo getting ready for the big test: full-scale war with China.

Further incidents followed, but the Japanese were still furiously building up their forces. By 1937 they were ready, and still the Chinese had no air force worthy of the name. Despite the leadership of General Chiang Kai-shek, the Chinese air defences comprised a motley collection of imported Western aircraft, without any proper planning and with a complete absence of an infrastructure of training, skilled ground staff or even Chinese pilots, except for a handful who owed their position to family influence. Thus, when on 7 July 1937 the Imperial Japanese Army, scorning incidents, simply marched from Manchukuo into northern China there was little to stop them in the air. This time it was full-scale war, which was not to be over until the total capitulation of Japan in August 1945 (by which time the problem in China was civil war with the growing Communist armies).

The Imperial Japanese Army committed over 300 aircraft, but used them in close-support missions. It was left to the now very strong Imperial Japanese Navy to mount the main air campaign, initially from offshore carriers and increasingly from shore bases. Among the first types in action were the Nakajima A2N1 fighter, the Aichi D1A dive bomber (one of which caused diplomatic trouble by sinking the US gunboat *Panay*), the Kawanishi E7K reconnaissance seaplane and the superb Mitsubishi G3M long-range bomber. On 22 August 1937 a new monoplane fighter went into action, the Mitsubishi A5M1. Though armed only with the traditional two rifle-calibre machine-guns, just like a 1916 Sopwith Camel, the A5M had been designed to meet severe new requirements for speed, climb and manoeuvrability. It was perhaps the first of the new cleanly streamlined monoplane fighters to demonstrate in actual combat its ability not only to outperform traditional biplanes but also to outmanoeuvre them. As early as 4 September a group from *Kaga* met a gaggle of Chinese Curtiss Hawk II and III biplanes over Kaoyu-Hu and promptly shot down three.

This was just the first of countless encounters with the A5M which were to prove the end of the road for the aircraft wearing the 12-pointed white star of China. There was still no proper Chinese air force, and not knowing what else to do Chiang Kai-shek personally hired a capable US Army fighter pilot, who was being invalided out on medical grounds, to accept the post of air adviser. His name was Clair Lee Chennault, and his desperate struggle against graft, disinterest, inefficiency and lack of almost everything eventually did put a little muscle into what had been a lost cause. In 1941 Chennault's scouting for volunteers had resulted in the formation of the famed AVG (American Volunteer Group), or Flying Tigers, which at last gave the Japanese something to think about in Chinese skies.

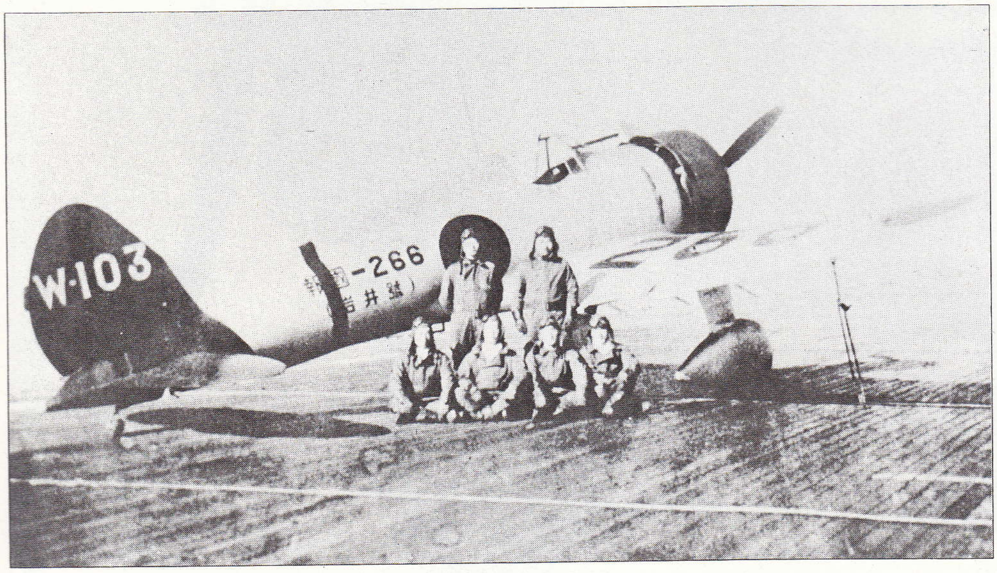
The brilliant performance of the A5M was all too familiar to Chennault, who sent Washington detailed reports which were obviously filed rather than read. Nothing got into the Western air magazines, and three years later history was to repeat itself exactly when the next-generation Mitsubishi A6M Reisen engaged in deadly combat over China, proving more than a match for Chennault's best fighter, the Curtiss P-40. Again, nobody read the reports, so the Reisen (Zero) was a terrible shock in December 1941.

By 1938 the A5M2 was ranging far over China with a drop tank under its belly, getting the best of such modern Western fighters as the Dewoitine D.510 and Gloster Gladiator. In the bitter winter the A5Ms had been modified with a sliding canopy and cockpit heater, but the Japanese pilots disliked the canopy and had it eliminated from the A5M4, the final version. Many other fighter pilots around the world, notably in Italy, thought the same way, and Italian fighters had predominantly open cockpits until their armistice in September 1943!

The Nomonhan Incident

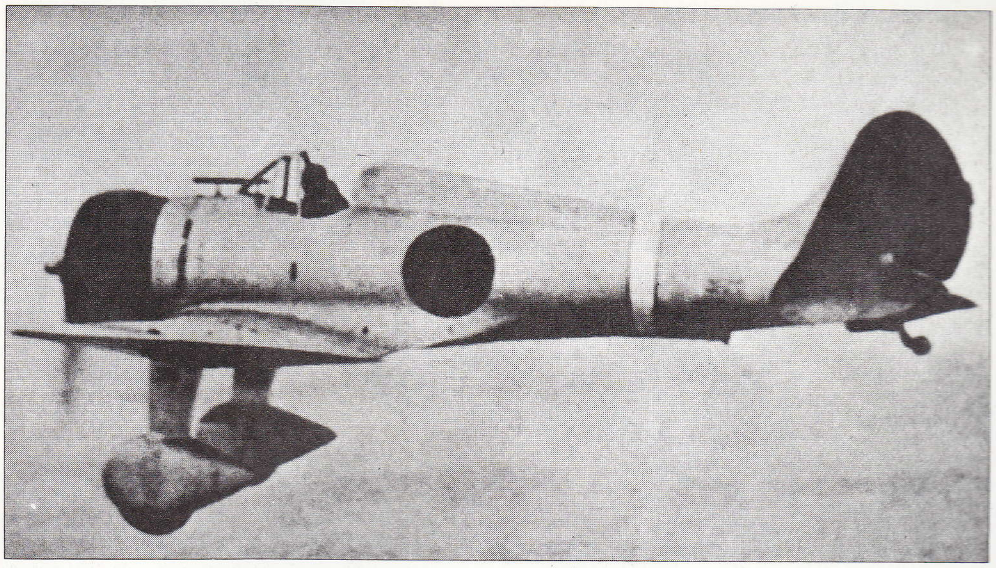
Meanwhile a completely different conflict had flared up in the depths of central Asia. In early 1933 the Japanese army had occupied a province of Mongolia, angering the locals who insisted that their frontier lay far to the east on the rugged and desolate Nomonhan plateau. There was constant friction and a series of border clashes. Then in spring 1938 the apprehensive Soviet Union occupied and fortified the Changkufeng Hill near the junction of the frontiers of the Siberian SSR, Manchukuo and Korea. The bellicose Japanese army instantly went to war, but was expressly denied air power. It was Soviet aircraft, notably the 60 locally based Tupolev TB-3 four-engine heavy bombers, that forced the Japanese to pull back.

This tended to make Japan regard the Soviet Union as the chief enemy, and plans were laid for massive production of army aircraft designed for close support in cold-weather operations. No great importance was attached to long range, with the result that, unlike those of the navy, most of the army aircraft in World War II were initially ill-suited to the vast battle theatres of the Pacific. But worse was to come. On 10 May 1939 there occurred one Nomonhan border incident too many: Mongolian nomads were driven back across the Khalkin Gol (river), and Mongolian forces hit back. In 1936



Pilots of Soryu's fighter element pose beside an A5M4 on the deck of the carrier. Carrier aircraft played a great part in the battle against China, helping to implement the blockade.

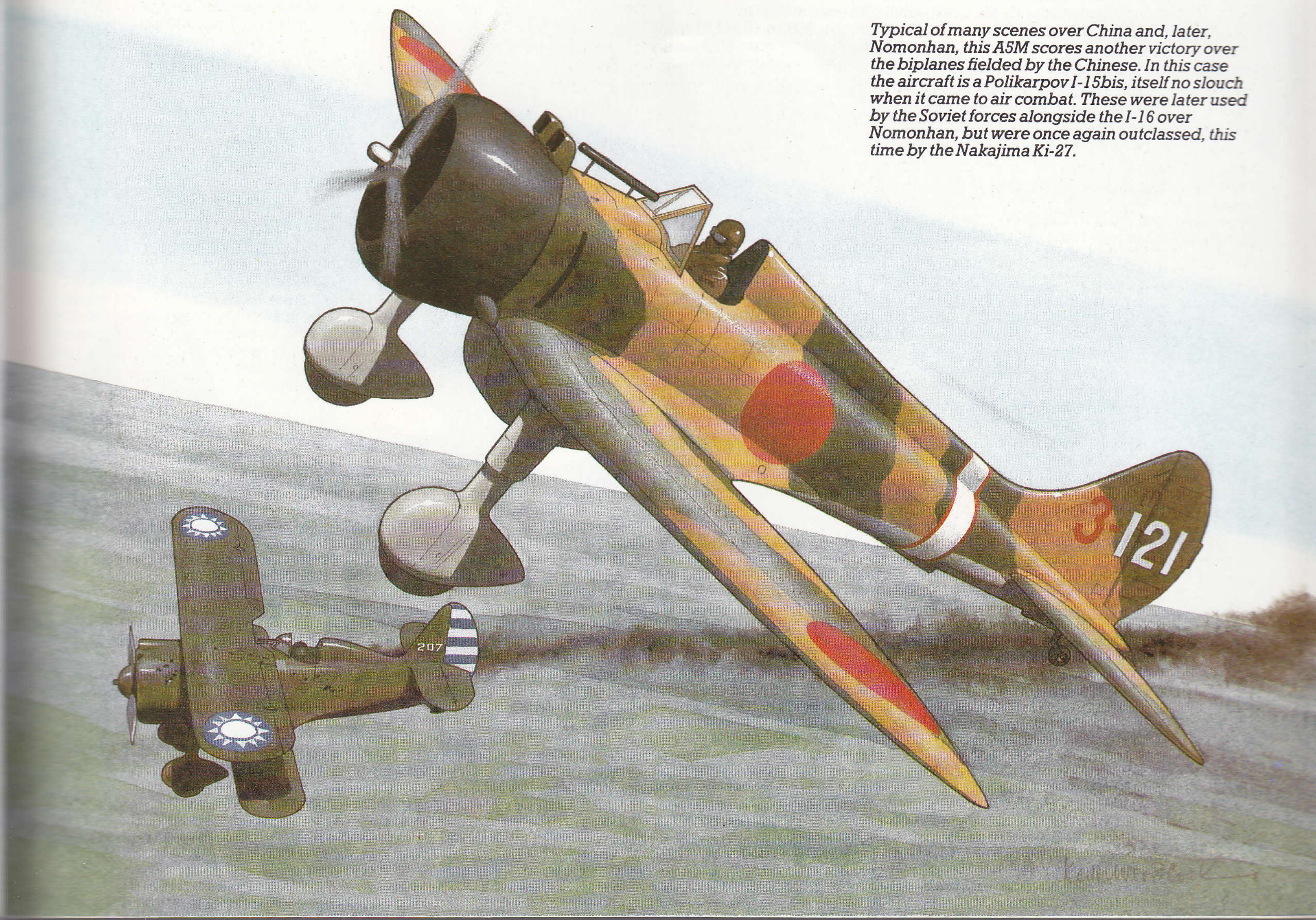
On patrol over China, this A5M shows the clean lines which typified the marque. Its phenomenal agility enabled the A5M not only to outfight its biplane opposition but also to outfly them.



Mongolia and the Soviet Union had concluded a mutual assistance pact, and within 24 hours the Soviets were reinforcing their local 1st Army Group (whose commander was young Georgi K. Zhukov, later to become the greatest of all Soviet marshals) and bringing up two V-VS fighter regiments, one flying Polikarpov I-16 Type 10 and the other a mix of I-16s and the Polikarpov I-15bis biplane, as well as other units flying the Polikarpov R-Zet tactical reconnaissance aircraft and the giant TB-3. The Japanese were itching to avenge their frustration at Changkufeng, and this time it was full-scale war, with no holds barred. In particular, the Imperial Japanese Army wanted to have a fresh conflict where it could test its latest equipment, the far-flung Chinese war having become bogged down by supply difficulties, distance and an inability to mount a decisive battle.

Over the next four months, until 16 September 1939, the undeclared Nomonhan war was the biggest air war the world had yet seen. The scale of fighting within an area roughly 100 miles (160 km) square exceeded anything seen in a similar block of airspace even in World War I. At the start the Imperial Japanese Army deployed four *hikodans* (air divisions) but soon augmented these forces, while the V-VS strength was to be more than trebled, an important addition being the Tupolev SB-2 fast bomber. The chief Japanese fighter was the Nakajima Ki-27b, a close parallel to the A5M; the main tactical machines were the Mitsubishi Ki-15 and Mitsubishi Ki-30, while the heavy bombers were the new Mitsubishi Ki-21 and the Fiat B.R.20.

There is no point in attempting a detailed account of this war, which ebbed to and fro both on the ground and in the sky. The Soviet pilots outnumbered their enemies but were totally inexperienced and crippled by rigid political control, which stifled initiative in combat. The Japanese were skilled and experienced, but gradually the Soviet V-VS gained the upper hand as the pilots who survived gained the combat experience needed to win, and the skilled Japanese began to be replaced by raw recruits with fewer than 30 hours on the Ki-27. What had begun as a useful bit of experience turned out to be more costly than either side had anticipated.



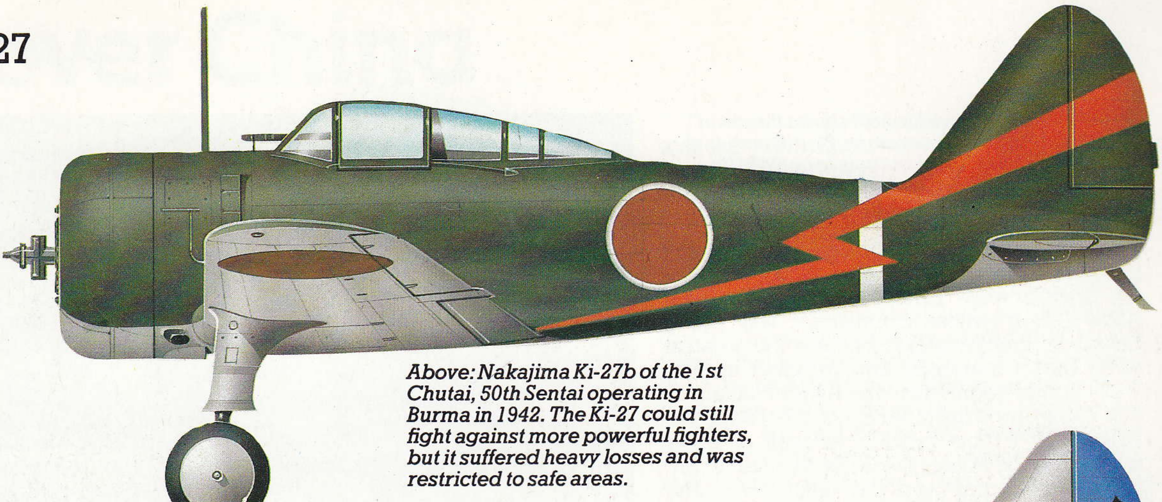
Typical of many scenes over China and, later, Nomonhan, this A5M scores another victory over the biplanes fielded by the Chinese. In this case the aircraft is a Polikarpov I-15bis, itself no slouch when it came to air combat. These were later used by the Soviet forces alongside the I-16 over Nomonhan, but were once again outclassed, this time by the Nakajima Ki-27.

JAPAN

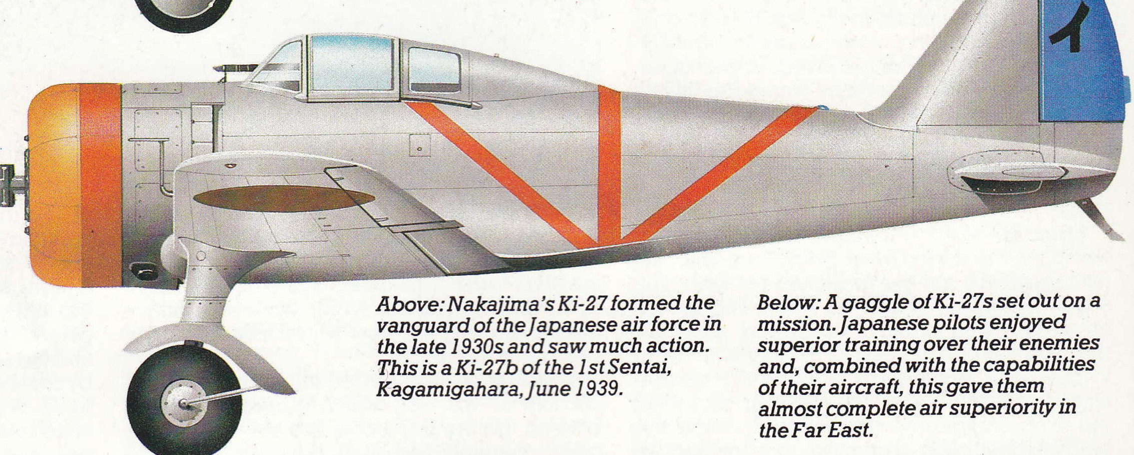
Nakajima Ki-27

History must severely criticize many important European aircraft companies, including almost all those in the UK, for their extreme reluctance to switch from traditional airframes to the smooth all-metal stressed-skin form. As early as 1927 this had been demonstrated to be superior, quite apart from permitting improved streamlined aircraft. No such criticism can be levelled at Japan, whose chief military prototypes of the 1934-8 period were almost exclusively outstanding in structural terms. They also had advanced engine installations (with constant-speed propellers as soon as they could be produced), flaps, sliding canopies and very modern systems. All these were features of the Imperial Japanese Army's **Nakajima Ki-27**, first flown on 15 October 1936. Where it did not score was in its extreme lightness of structure and armament, in order to get the best possible performance and manoeuvrability from an engine that was merely an improved licence-built Bristol Jupiter.

From the start the Ki-27 was a winner, and by April 1938 large numbers were sweeping all before them over China. It did not matter that they lacked armour, self-sealing tanks and firepower, when in speed, climb and manoeuvrability they far surpassed every other aircraft they encountered. In 1940 production was handed over to the Mansyu company in the puppet state of Manchukuo, terminating at 3,396 in the spring of 1942. It was the very success of the Ki-27 that led the army to follow the same formula in its next fighter, the Nakajima Ki-43. Though some pilots built up impressive scores with both types, the Ki-43 was soon unable to cope with the much more powerful and tougher fighters it was having to meet.

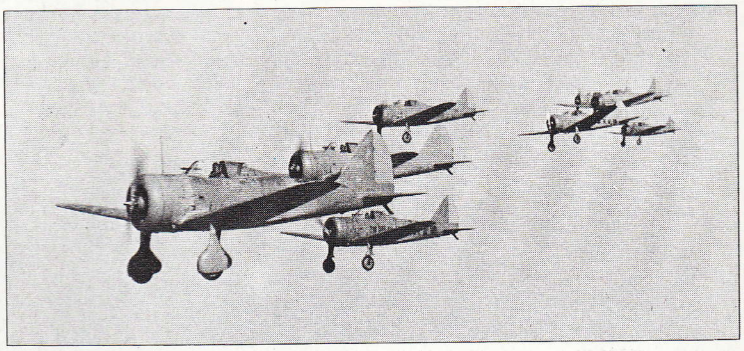


Above: Nakajima Ki-27b of the 1st Chutai, 50th Sentai operating in Burma in 1942. The Ki-27 could still fight against more powerful fighters, but it suffered heavy losses and was restricted to safe areas.



Above: Nakajima's Ki-27 formed the vanguard of the Japanese air force in the late 1930s and saw much action. This is a Ki-27b of the 1st Sentai, Kagamigahara, June 1939.

Below: A gaggle of Ki-27s set out on a mission. Japanese pilots enjoyed superior training over their enemies and, combined with the capabilities of their aircraft, this gave them almost complete air superiority in the Far East.



Specification

Nakajima Ki-27b

Type: single-seat monoplane fighter-bomber

Powerplant: one 780-hp (582-kW) Nakajima Kotobuki Ha-1 nine-cylinder air-cooled radial piston engine

Performance: maximum speed 470 km/h (292 mph) at 3500 m (11,480 ft); climb to 3000 m (9,845 ft) in 2 minutes 59 seconds; service ceiling 12250 m (40,190 ft); range (with two underwing drop tanks) 1100 km (683 miles)

Weights: empty 1110 kg (2,447 lb) maximum take-off 1790 kg (3,946 lb)

Dimensions: span 11.31 m (37 ft 1¼ in); length 7.53 m (24 ft 8½ in); height 3.28 m (10 ft 8 in); wing area 18.56 m^2 (200 sq ft)

Armament: two 7.7-mm (0.303-in) Type 80 (Vickers) machine-guns, plus four 25-kg (55-lb) bombs

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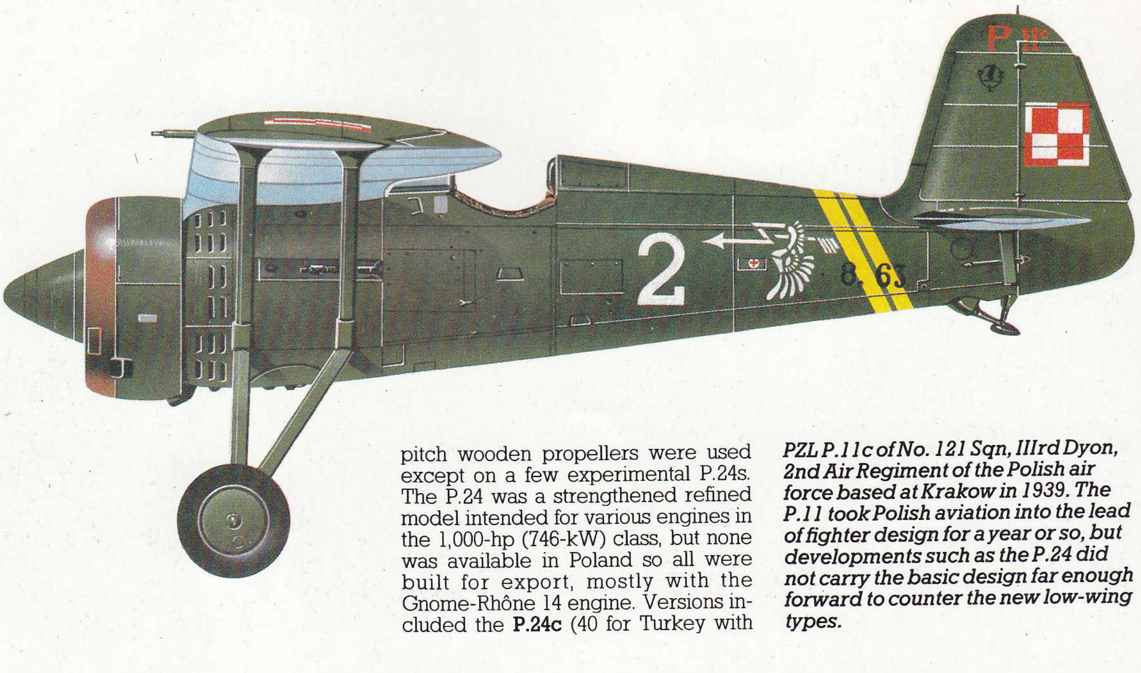
POLAND

PZL P.24

In 1927 the PZL company was set up in Warsaw to create advanced all-metal aircraft. Daringly the first design, the **PZL P.1** fighter, was entrusted to Zygmund Pulaski, an unknown young graduate of Warsaw Technical University. His creation was one of the true masterpieces of fighter design, and it placed Poland in the forefront of fighters for almost 10 years, leading through the **P.7** and **P.11**, built in large numbers for the Polish air force, to the ultimate member of the family, the **P.24**.

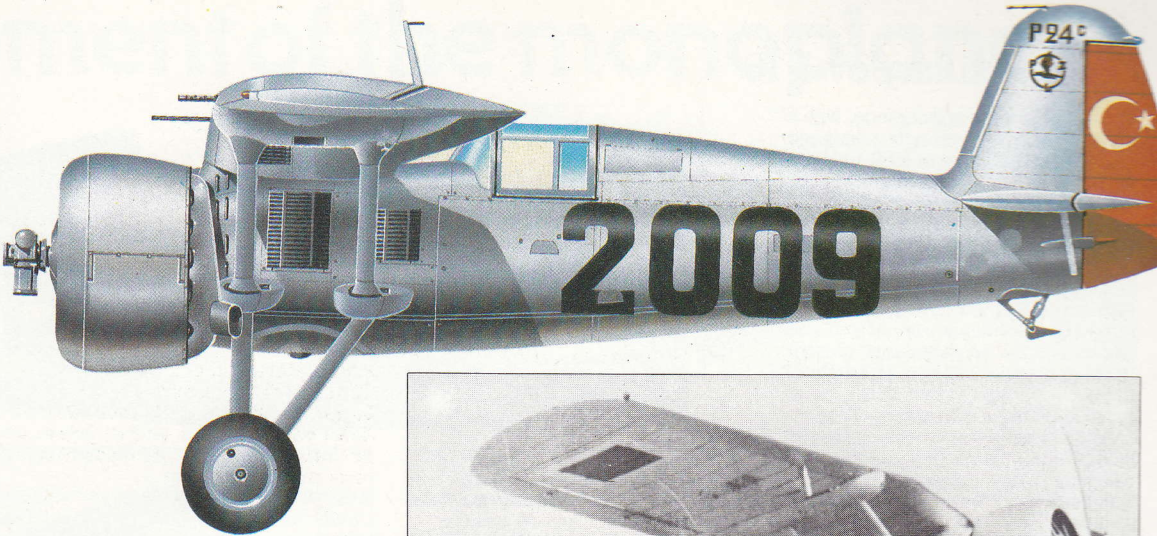
The main feature of all these fighters was the 'Pulaski wing' which combined stressed-skin construction with the advanced Bartel aerofoil profile and a tapered gull root which reduced drag and improved pilot view. The fuselage was also of stressed-skin semi-monocoque construction, and this not only combined toughness with light weight but also opened up via numerous hatches to give superb access for servicing. From the first P.7 the radial engine was well cowled, though fixed-pitch wooden propellers were used except on a few experimental P.24s. The P.24 was a strengthened refined model intended for various engines in the 1,000-hp (746-kW) class, but none was available in Poland so all were built for export, mostly with the Gnome-Rhône 14 engine. Versions included the **P.24c** (40 for Turkey with



PZL P.11c of No. 121 Sqn, IIIrd Dyon, 2nd Air Regiment of the Polish air force based at Krakow in 1939. The P.11 took Polish aviation into the lead of fighter design for a year or so, but developments such as the P.24 did not carry the basic design far enough forward to counter the new low-wing types.

two cannon and two machine-guns, or four machine-guns), the **P.24e** for Romania (two cannon and two machine-guns), the **P.24F** for Bulgaria (same), the **P.24f** and **P.24g** for Greece (G with four machine-guns) and the unbuilt **P.24p** for Poland ordered just before the German invasion. Almost all the P.24s saw action during World War II.

Specification
PZL P.24f
Type: single-seat monoplane fighter-bomber
Powerplant: one 970-hp (723-kW) Gnome-Rhône 14 N7 14-cylinder two-row air-cooled radial piston engine
Performance: maximum speed 430 km/h (267 mph) at 4250 m (13,940 ft); climb to 5000 m (16,405 ft) in 5 minutes 40 seconds; service ceiling 10500 m (34,450 ft); range 800 km (497 miles)
Weights: empty 1326 kg (2,924 lb); normal take-off 1920 kg (4,232 lb)
Dimensions: span 10.72 m (35 ft 2 in); length 7.51 m (24 ft 7½ in); height 2.70 m (8 ft 10½ in); wing area 17.9 m^2 (192.7 sq ft)
Armament: two 20-mm Oerlikon FF cannon and two 7.7-mm (0.303-in) KM machine-guns (all in the wings), plus two bombs of up to 50 kg (110 lb) each

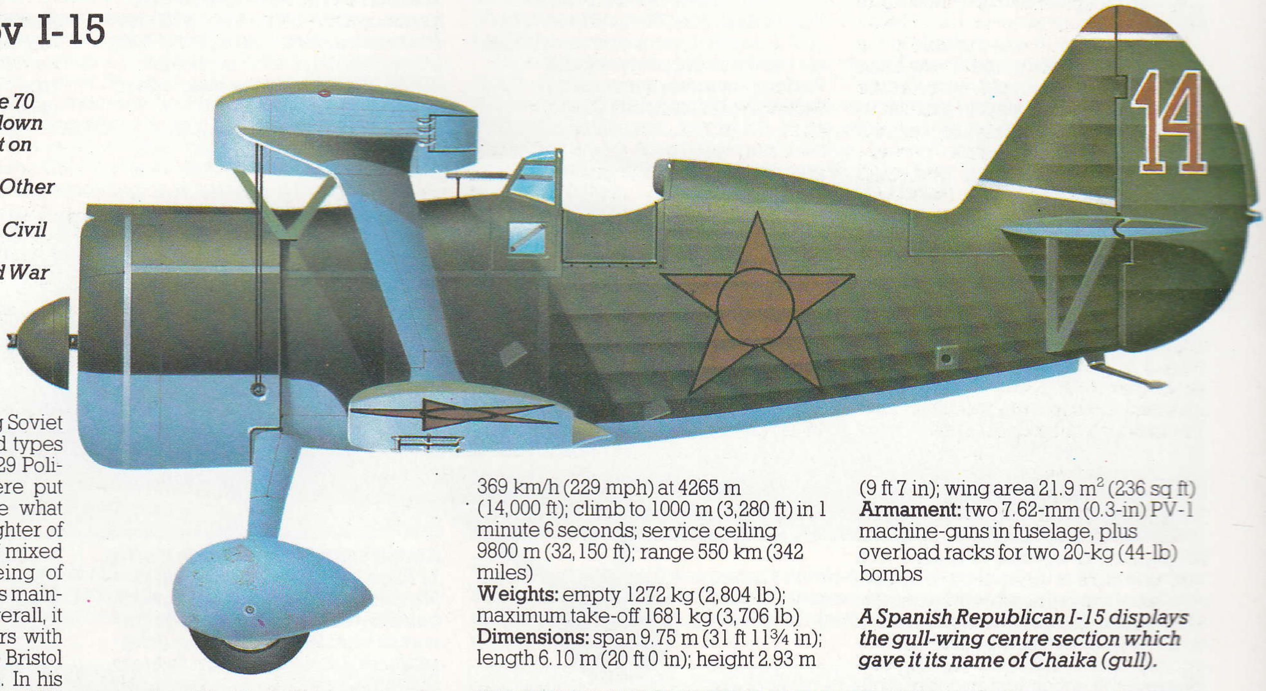


Above: PZL P.24c of the Turkish air force's 4th Regiment, which was based at Kutahya in 1939. P.24s were also flown by Bulgaria, Greece and Romania.

Right: The P.24 was an improved version of the P.11 featuring enclosed cockpit and strengthening. It was the ultimate model of the Pulaski gull-wing family. This is a Turkish P.24c.

USSR

Polikarpov I-15



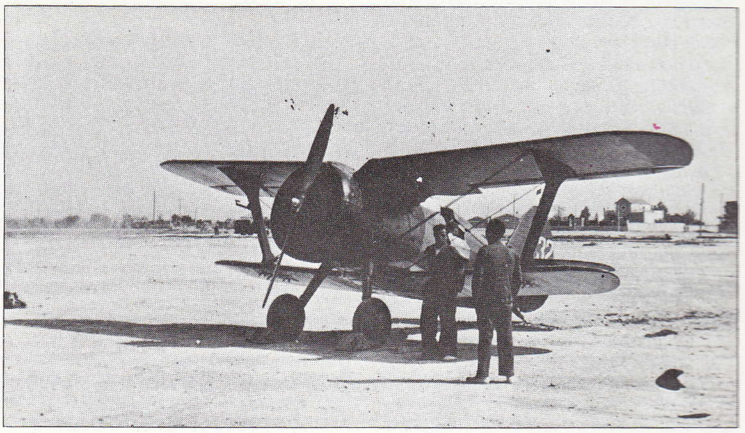
Polikarpov I-15bis (I-152) of the 70 IAP, V-VS (Soviet air force) as flown during the Nomonhan incident on the Manchukuoan-Mongolian border in the summer of 1939. Other actions in which the aircraft participated were the Spanish Civil War, Winter War and the Sino-Japanese war, as well as World War II.

N.N. Polikarpov was the leading Soviet designer of fighters and related types before World War II. In late 1929 Polikarpov and his colleagues were put into a special prison to create what became the **I-5**, the standard fighter of its day. A traditional biplane of mixed construction, the fuselage being of welded steel tube and the wings mainly wood, with fabric covering overall, it was built in substantial numbers with the M-22 licensed version of the Bristol Jupiter, and gave good service. In his final months in detention, in early 1933, Polikarpov examined ways of improving the I-5 and in October 1933 the prototype **Polikarpov I-15** demonstrated outstanding all-round handling, with the ability to complete a 360° turn in 8 seconds.

Compared with the I-5 the I-15 had a more powerful Cyclone engine, trim cantilever landing legs with internal oleo struts, and a gull type upper wing which gave rise to the name Chaika (gull). Cyclones could not readily be made under licence, as the M-25, so the first 404 I-15s had the old M-22 engine, with a duralumin ground-adjustable propeller. In January 1936 production switched to imported Cyclone F3 geared engines with the Hamilton bracket-type two-pitch propeller. The final 270, bringing the total to 677, had the M-25 driving the AV-1 (licensed Hamilton) propeller, reduced fuel and four fuselage PV-1 guns with 3,000 rounds. Together with the improved **I-15bis (I-152)**, the I-15 saw much action in Spain and the Far East, leading to the faster retractable-gear **I-153** which also saw action against the Japanese in 1939, several thousands being built.

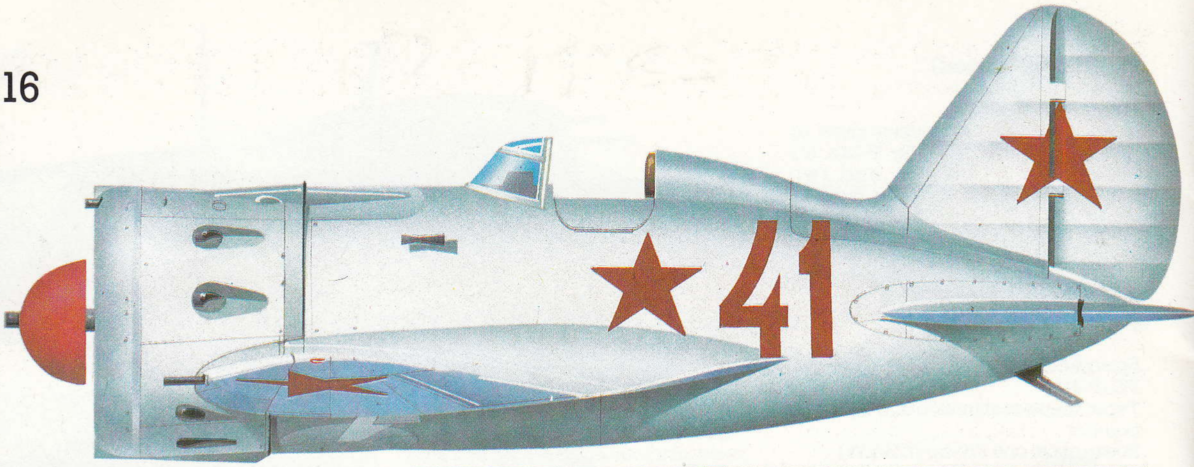
Specification
Polikarpov I-15
Type: single-seat fighter-bomber
Powerplant: one 710-hp (529-kW) Wright Cyclone SGR-1820-F3 nine-cylinder air-cooled radial piston engine
Performance: maximum speed 369 km/h (229 mph) at 4265 m (14,000 ft); climb to 1000 m (3,280 ft) in 1 minute 6 seconds; service ceiling 9800 m (32,150 ft); range 550 km (342 miles)
Weights: empty 1272 kg (2,804 lb); maximum take-off 1681 kg (3,706 lb)
Dimensions: span 9.75 m (31 ft 11¾ in); length 6.10 m (20 ft 0 in); height 2.93 m (9 ft 7 in); wing area 21.9 m^2 (236 sq ft)
Armament: two 7.62-mm (0.3-in) PV-1 machine-guns in fuselage, plus overload racks for two 20-kg (44-lb) bombs

A Spanish Republican I-15 displays the gull-wing centre section which gave it its name of Chaika (gull).



USSR

Polikarpov I-16

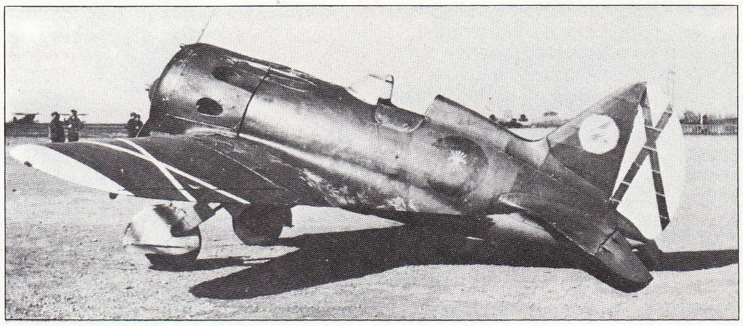


Above: Polikarpov I-16 Type 24 of 4 IAP, V-VS operating in the Lake Ladoga region near Leningrad in the winter of 1940-1. The I-16 was the Soviets' main fighter at the outbreak of war.

Though of bizarre appearance, with a stumpy fuselage seemingly influenced by the Gee Bee racer of 1932, the **Polikarpov I-16** was a landmark in fighter design. Though it had a traditional structure with semi-monocoque wooden fuselage and metal wings fabric-covered aft of the front spar, the I-16 was a clean cantilever monoplane with fully retracting landing gear, the first to go into military service. It was planned as the fast monoplane partner to the agile but slower I-15 family of biplanes. Though it had many faults, the I-16 sustained a massive production programme in many versions, and though totally outmoded in June 1941 was kept in production until early 1942, the final total being 7,005 single-seaters plus at least 1,639 two-seaters (mainly **UTI-4** trainers).

Flown on the last day of 1933, the prototype had a Cyclone engine, and early production (preceded by a few with the M-22 Jupiter) had the licensed M-25 version. Some of the later models had the improved M-62 or M-63 of up to 1,100 hp (820 kW). A host of different armament schemes was used, the **I-16 Type 17** being preceded by versions with two or four ShKAS or two ShVAK, while later aircraft often had four ShKAS and a 12.7-mm (0.5-in) BS. Many carried six or eight RS-82 rockets, while the **I-16 Type 24** could carry bombloads up to 500 kg (1,102 lb) in weight.

In action the I-16 was unstable to the point of being tricky, and it was tiring because the pilot could never relax. This also made it difficult to aim accurately, but against this must be set what was perhaps the fastest roll of any fighter of the day and outstanding all-round performance and manoeuvrability. In the first year fighting the Luftwaffe thousands were shot down or destroyed on the ground, but in Spain and the Far East in earlier wars they were formidable.



Seen after capture by the Spanish Nationalists, this I-16 typifies the Republicans' best fighter.

Specification

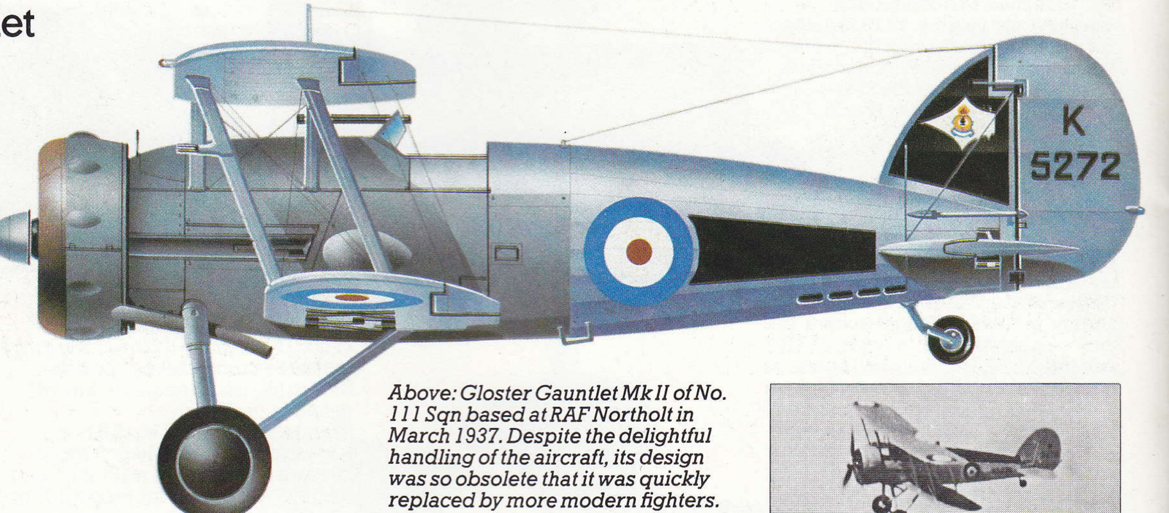
Polikarpov I-16 Type 17

Type: single-seat fighter-bomber
Powerplant: one 750-hp (559-kW) M-25V (licensed Cyclone) nine-cylinder air-cooled radial piston engine
Performance: maximum speed 440 km/h (273 mph) at 5000 m (16,405 ft); climb to 5000 m (16,405 ft) in 7 minutes; service ceiling 8400 m (27,560 ft); range 800 km (497 miles)
Weights: empty 1495 kg (3,296 lb); maximum take-off 1810 kg (3,990 lb)
Dimensions: span 9.00 m (29 ft 6⅓ in); length 5.98 m (19 ft 7½ in); height 2.56 m (8 ft 4¾ in); wing area 14.54 m^2 (156.5 sq ft)

Armament: two 7.62 mm ShKAS machine-guns in fuselage and two 20-mm ShVAK cannon in wings, plus (late type 17) two 100-kg (220.5-lb) bombs or six RS-82 rockets

UK

Gloster Gauntlet



Above: Gloster Gauntlet Mk II of No. 111 Sqn based at RAF Northolt in March 1937. Despite the delightful handling of the aircraft, its design was so obsolete that it was quickly replaced by more modern fighters.

From the later Nieuport scouts of World War I the designer Harry P. Folland created fine and exceptionally agile radial-engined fighters for the RAF throughout the inter-war era. Around 1930 the Gloster company built the **S.S.18** and **S.S.19** prototypes which were increased in span and length and matched to the more powerful engines becoming available. Eventually the best engine was found to be the Mercury, smaller in diameter than the Jupiter used in the previous-generation Gloster Gamecock but more powerful. It was installed in a ring-type cowl, but driving an old wooden propeller. The airframe had a light-alloy structure with fabric covering except for the forward fuselage which was covered in removable aluminium panels for easy access. For increased rigidity and strength the wings had two-bay strutting (two sets of interplane struts on each side).

Almost entirely because of the better engine and great attention to detail design the final prototype, the **S.S.19B**, was much faster than the Gamecock, Bristol Bulldog and other RAF fighters, and considerably faster even than the smaller Hawker Fury. It proved to be an exceptionally fine aircraft, and was adopted for the RAF as the **Gloster Gauntlet**. Gloster delivered 24 **Gauntlet Mk I** fighters from 1935, followed by 104 **Gauntlet Mk IIs** with a completely different Hawker-type structure (a result of Gloster's merger into the Hawker Siddeley Group in 1935). Most Gauntlets were later fitted with a three-blade Fairey-Reed metal propeller, though still of fixed pitch. Exports were made to seven countries, four of them receiving secondhand ex-RAF machines. Those of Finland saw more action in the Winter War in 1939 than those of the RAF, which took part in only a few combats in the Middle East in 1940.

Right: The Gauntlet was the last open-cockpit fighter to serve with the RAF. The aircraft of Finland were the ones to see the most action – during the Winter War of 1940, when they were flown with considerable skill and bravery against the more numerous Polikarpov fighters.

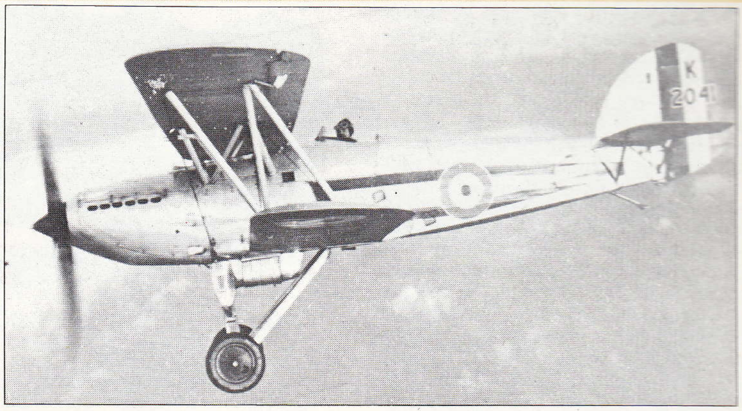
Specification

Gloster Gauntlet Mk II

Type: single-seat day and night fighter
Powerplant: one 645-hp (481-kW) Bristol Mercury VIS2 nine-cylinder air-cooled radial piston engine
Performance: maximum speed 370 km/h (230 mph) at 4815 m (15,800 ft); climb to 6095 m (20,000 ft) in 9 minutes; service ceiling 10210 m (33,500 ft); range 740 km (460 miles)
Weights: empty 1259 kg (2,775 lb); normal take-off 1801 kg (3,970 lb)
Dimensions: span 9.99 m (32 ft 9½ in); length 8.05 m (26 ft 5 in); height 3.12 m (10 ft 3 in); wing area 29.26 m^2 (315 sq ft)
Armament: two 7.7-mm (0.303-in) Vickers machine-guns in sides of fuselage

Development of the monoplane fighter

In the early years of the 1930s, fighter aircraft were basically similar to the fabric and wire contraptions of 1918. By 1939, however, the most advanced air forces were operating high-speed, stressed-skin, multi-gun aircraft of vastly greater performance. In fact, the decade saw a great leap in the evolution of the fighting aeroplane.



The classic Hawker Fury was the culmination of British biplane fighter development, its fabric and wire construction harking back to the combatants over the Western Front in 1918. Further types were to be developed, but the days of the biplane were numbered.

It so happened that by 1930 many well-known features in aircraft design had been around long enough for them to be assembled as a group into new types of fighter. Had this been done earlier, the aircraft would probably have been branded as a freak. By the 1930s some (but not all) air forces were ready to accept change.

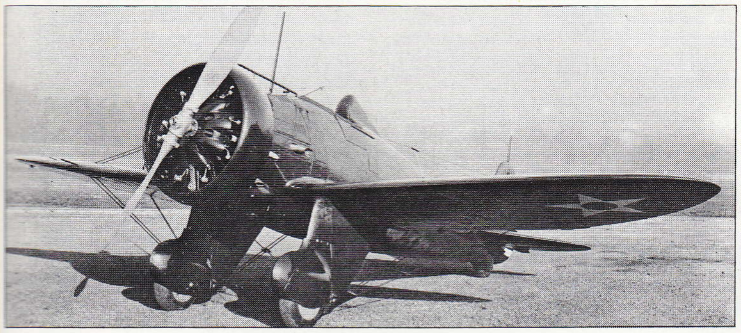
In 1930 the world's fighters were World War I in concept, with a skeleton-like airframe (some still wood but mostly steel tube or light alloy) covered with fabric, and braced by wires. Most were biplanes, but a few were monoplanes, usually of the parasol type with the wing well above the fuselage. Armament was typically two machine-guns, and none of the new features were usually included.

What were these features? One was semi-monocoque construction; instead of having light skin on a strong skeleton it is possible to put the strength into the skin as in the claw of a lobster. Albatros scouts of 1916 had fuselages of this type, though in wood. When this construction was tried in metal it opened the way to 'stressed-skin' aircraft of almost perfect aerodynamic shape, with cantilever monoplane wings and no wires. Previous monoplanes had thrown away their theoretical gains in efficiency by having very deep wings or else a profusion of struts and wires. Stressed-skin wings could be quite thin, yet fully cantilevered.

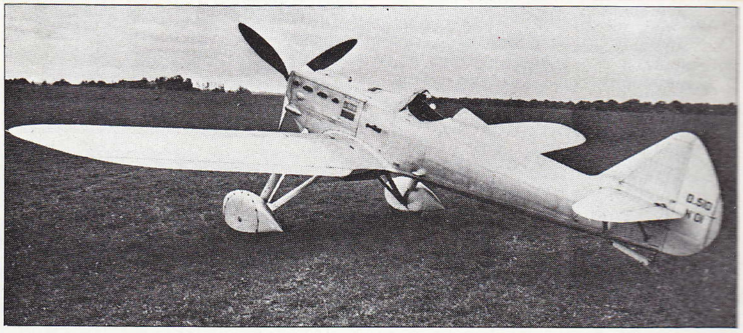
Engines grew swiftly in power, from 500 hp (373 kW) of 1930 to 1,000 hp (746 kW) by 1935 and 2,000 hp (1491 kW) in prospect. Installations were vastly improved, especially for air-cooled radials which, though superior in simplicity, compactness (giving fighters better manoeuvrability) and performance in very cold or very hot climates, had previously been so crudely installed that they could not compete for speed with water-cooled Vee-12 and similar engines. Instead of being carved from laminations of wood in one piece from tip to tip, propellers were given separate blades mounted in a hub containing provision for rotating the blades in their sockets: fine pitch for take-off, coarse pitch for high speed. First flown before 1920, the idea had never got into production, though by 1930 engineers had invented the CSU (constant-speed unit) which could vary the pitch of the blades automatically according to airspeed and throttle setting.

Retractable landing gear had flown in 1920, but fighters of the early 1930s did not use them. Nobody had demonstrated that the complex mechanical horrors of the first such gears were unnecessary, and that they could be strong and simple. Again, cockpits had had sliding canopies from 1914, but they mostly used Celluloid, giving poor long-range visibility, and fighter pilots rejected them. Voice radio, oxygen and night-flying equipment were becoming standard by 1930, and armament was being dramatically increased. Two rifle-calibre machine-guns were no longer enough, and while the UK chose four and then eight such weapons others picked the big 'fifty-calibre' (12.7-mm/0.5-in) gun or even cannon of 20-, 23- or 37-mm size. All this, and the bombs and rockets added by the Soviets (bombs also by the US Navy) added weight, so flaps and often slats were needed to fit the highly loaded new monoplanes into the small fields.

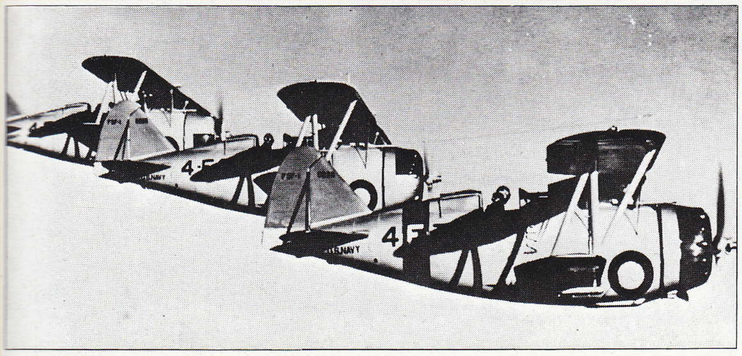
No single type brought in all the new ideas. Dewoitine had the nerve to use a stressed-skin monoplane wing in his D.500; Boeing flew its P-26 earlier but cluttered it up with bracing. Polikarpov was first to combine a cantilever wing with retractable gear, but much of the wing was fabric-covered in early I-16s. Grumman was a retractable-gear pioneer, but with biplanes. Probably the first fully modern fighter was the prototype Bf 109 of May 1935, but that is discussed in another issue.



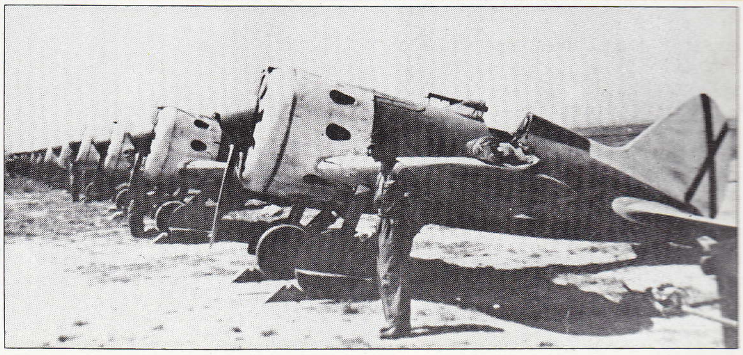
The Boeing P-26 'Peashooter' first flew in March 1932, introducing the monoplane into USAAC service. Tricky to handle, the P-26 retained some features of its predecessors, notably the heavily-spatted fixed landing gear and the externally braced wing.



The Dewoitine D.510 was one of a series of highly advanced aircraft in France in the early 1930s. The unbraced stressed skin wing was far in advance of its contemporaries, although the fixed, spatted landing gear added a somewhat clumsy touch.



The Grumman F3F was a typical product of the 'Grumman Ironworks', being immensely strong. The retractable landing gear was a Grumman speciality, and the line of biplane fighters was to lead to the Wildcat and Hellcat of World War II fame.



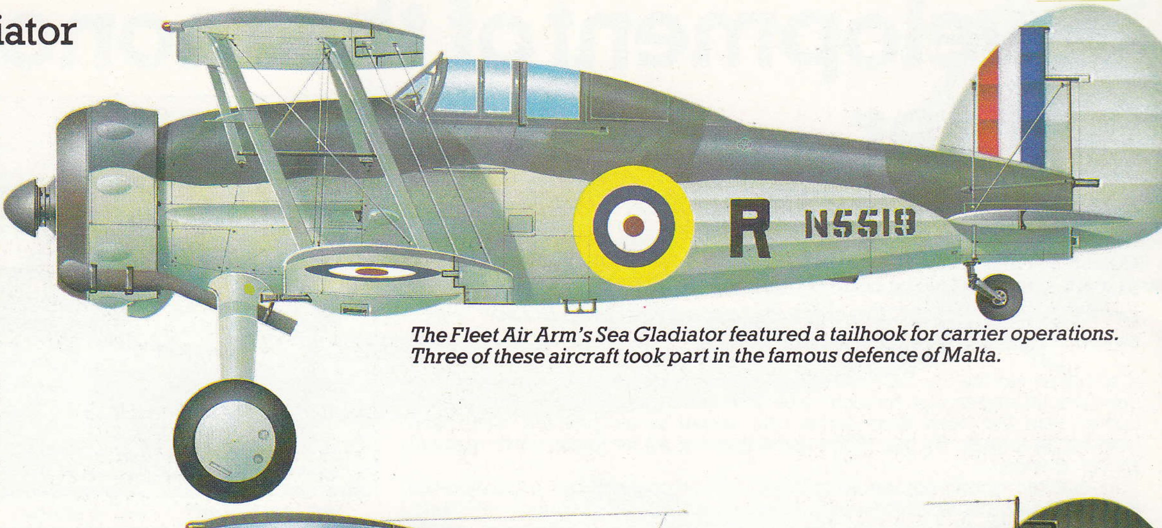
A landmark in fighter design, the Polikarpov I-16 was the first cantilever monoplane with fully retractable landing gear to enter military service. Early models had fabric-covered wings and a wooden fuselage structure.

UK

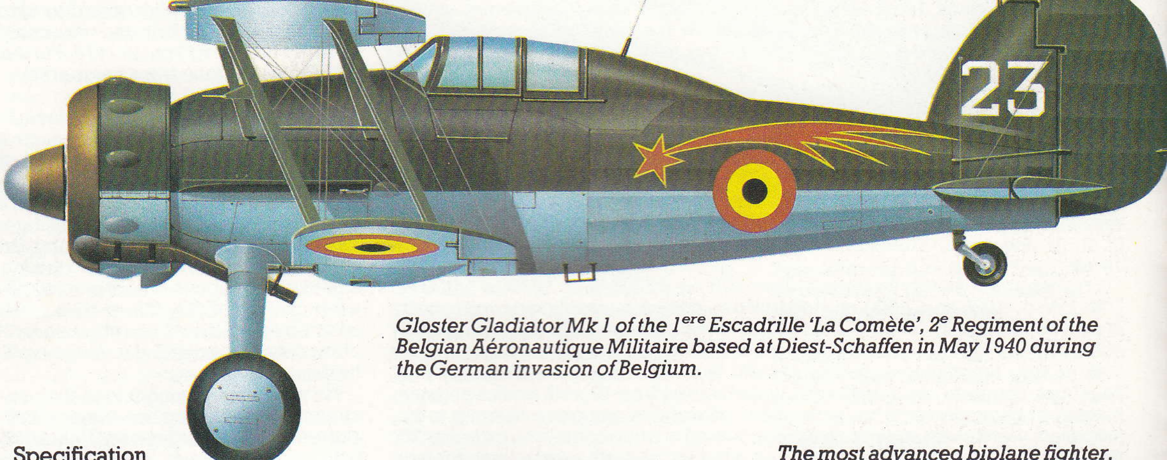
Gloster Gladiator

Representing the pinnacle of British biplane fighter development, the **Gloster Gladiator** continued the patented Hawker system of metal construction, the fuselage being built on a strong truss of tubes joined by gusset plates, and the wing having 'dumb-bell' spars built up from rolled steel strips formed into complex but cheap tubing. Covering was fabric except for detachable metal panels on the forward fuselage. Changes from the Gauntlet were a much more powerful Mercury engine, the single-bay wings, a strange oil radiator wrapped round the decking ahead of the cockpit, the doubling of the number of guns, the use of cantilever legs with Dowty internally sprung wheels, small split flaps on all four wings pumped down by a hand hydraulic pump, and the addition of a canopy, which was always left open.

The **S.S.37** prototype flew in September 1934. The Air Ministry had wasted years on the abortive F.7/30 specification and quickly decided to cut its losses and simply buy a production version of the S.S.37, ordering 23 **Gladiator Mk I** fighters in July 1935. By this time it was obvious to an impartial observer that such aircraft would probably be outclassed by the new monoplanes, especially as no Gladiator reached the RAF until March 1937. Orders continued, and from the 71st aircraft the two Vickers and underwing Lewis guns were replaced by four of the Brownings for which a licence had been obtained (even this gun was a 1916 pattern). The **Gladiator Mk II** had a Mercury VIIIA driving a three-blade Fairey-Reed metal propeller and desert equipment, while the Fleet Air Arm's **Sea Gladiator** had a hook and a dinghy. Gladiators sold well, 186 being exported before the war, but ex-Gauntlet pilots tended to prefer their old mounts (except for the better performance). Total production was 932. Gladiators saw much action in 1939-42, usually against larger numbers of far more formidable aircraft.



The Fleet Air Arm's Sea Gladiator featured a tailhook for carrier operations. Three of these aircraft took part in the famous defence of Malta.



Gloster Gladiator Mk 1 of the 1^{ere} Escadrille 'La Comète', 2^{e} Regiment of the Belgian Aéronautique Militaire based at Diest-Schaffen in May 1940 during the German invasion of Belgium.

Specification

Gloster Gladiator Mk II

Type: single-seat biplane fighter

Powerplant: one 830-hp (619-kW) Bristol Mercury VIIIA or VIIIAs nine-cylinder air-cooled radial piston engine

Performance: maximum speed 414 km/h (257 mph) at 4450 m (14,600 ft); climb to 3050 m (10,000 ft) in 4 minutes 30 seconds; service ceiling 10210 m (33,500 ft); range 714 km (444 miles)

Weights: empty 1562 kg (3,444 lb); normal take-off 2206 kg (4,864 lb)

Dimensions: span 9.83 m (32 ft 3 in); length 8.36 m (27 ft 5 in); height 3.22 m (10 ft 7 in); wing area 30.0 m^2 (323 sq ft)

Armament: four 7.7-mm (0.303-in) Browning machine-guns (two in the fuselage and two in the lower wings)

The most advanced biplane fighter, the Gloster Gladiator featured many advances over its predecessors but it was still not in the class of its monoplane cousins. Pilots of the Gladiator often fought hard and bravely, and during the first years of the war many kills were claimed by this tough aircraft. This example has been retained in flying condition by the Shuttleworth Trust.

USA

Boeing P-26

Ever innovative, Boeing Airplane Company took a leap forward in 1929 with the Model 200 Monomail, which had stressed-skin construction, a fully cantilever wing and retractable landing gear. The ultra-cautious US Army was not ready for such things, and it was not until September 1931 that the company at last went ahead at its own expense building the **Boeing Model 248** pursuit (fighter) aircraft. Even then it had fixed landing gear and a profusion of bracing wires, partly nullifying the modern all-metal semi-monocoque structure. The prototype flew in March 1932, and three aircraft were tested by the US Army as the **XP-936**.

The tubby monoplane was tricky to fly, landed fast and was thought dangerous on the US Army Air Corps' bumpy grass fields. One urgent modification was to add a giant headrest to protect the pilot in an overturn on the ground, which was not uncommon. The stall was very sudden, and pilots were generally apprehensive at this strange machine, but the US Army decided to adopt it and bought 136, designated **P-26A**. Resplendent in standard colours of blue body and yellow wings and tail they snarled round the US skies acquiring the nickname 'Peashooters', but by December 1941 survivors were in second-line service and saw action over the Philippines. By 1936 all had been fitted with flaps to slow the landing, and Boeing also built 25 **P-26B** fighters with fuel-injection engines and 23 **P-26C** aircraft with other changes, as well as 11 export **Model 281** fighters for China; these last saw action in 1937. Ex-US Army users included Guatemala and Panama.

Specification

Boeing P-26A

Type: single-seat monoplane fighter

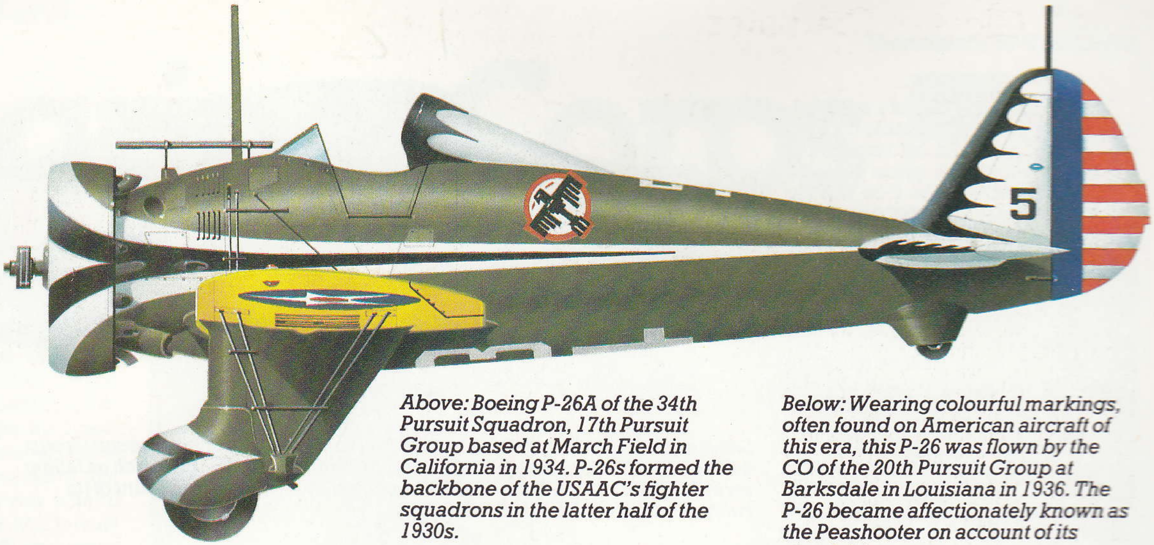
Powerplant: one 600-hp (447-kW) Pratt & Whitney Wasp R-1340-27 nine-cylinder radial piston engine

Performance: maximum speed 364 km/h (226 mph) at 4570 m (15,000 ft); climb to 4570 m (15,000 ft) in 8 minutes; service ceiling 8350 m (27,400 ft); range 917 km (570 miles)

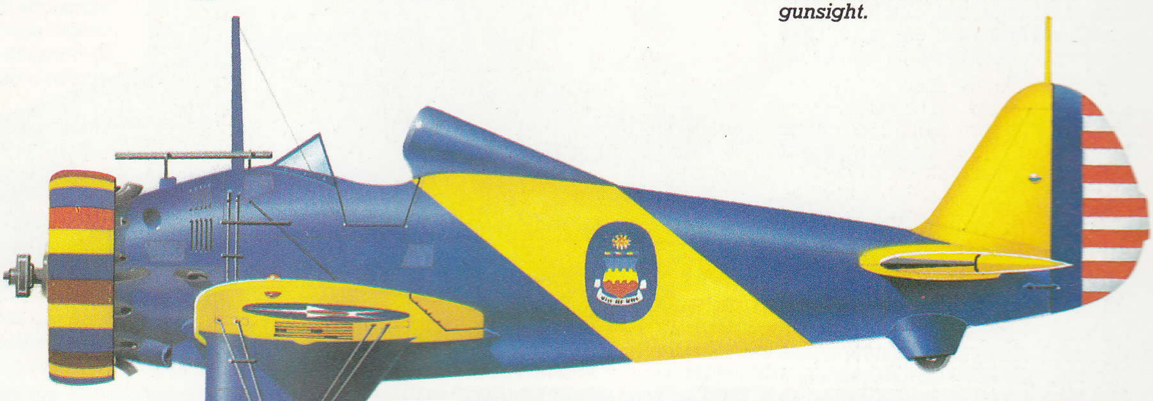
Weights: empty 1030 kg (2,271 lb); maximum take-off 1524 kg (3,360 lb)

Dimensions: span 8.52 m (27 ft 11½ in); length 7.19 m (23 ft 7¼ in); height 3.06 m (10 ft 0½ in); wing area 13.89 m^2 (149.5 sq ft)

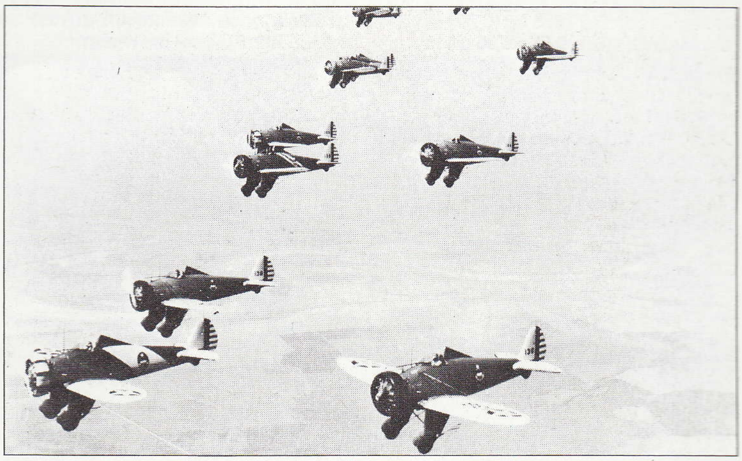
Armament: (left of fuselage) one 7.62-mm (0.3-in) Browning M2 machine-gun, and (right side) same or one 12.7-mm (0.5-in) Browning M1921 machine-guns, plus provision for two 45-kg (100-lb) bombs or five practice bombs



Above: Boeing P-26A of the 34th Pursuit Squadron, 17th Pursuit Group based at March Field in California in 1934. P-26s formed the backbone of the USAAC's fighter squadrons in the latter half of the 1930s.



Below: Wearing colourful markings, often found on American aircraft of this era, this P-26 was flown by the CO of the 20th Pursuit Group at Barksdale in Louisiana in 1936. The P-26 became affectionately known as the Peashooter on account of its gunsight.

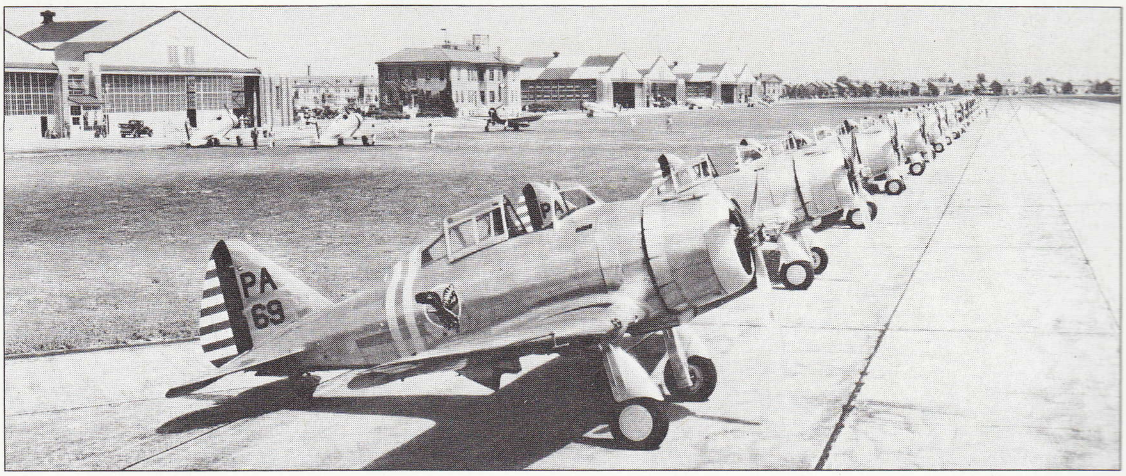


The P-26 was sturdy, agile and responsive but suffered from an extremely high landing speed and a vicious swing. Flaps were later added to help cure this problem but it always remained tricky to fly.

USA

Seversky P-35

The background to this aeroplane was odd, for it descended via several intermediate steps from Alex de Seversky's first aircraft, a three-seat civil amphibian seaplane! Most features of the airframe were unchanged in the **Seversky SEV-1XP** (experimental pursuit), a hurried rebuild of the two-seat **SEV-2XP** in July 1935, which did well in US Army trials despite a troublesome Cyclone engine. Re-engined (see specification) it won a 77-aircraft order, the fighters being delivered by August 1935 and designated **P-35**.

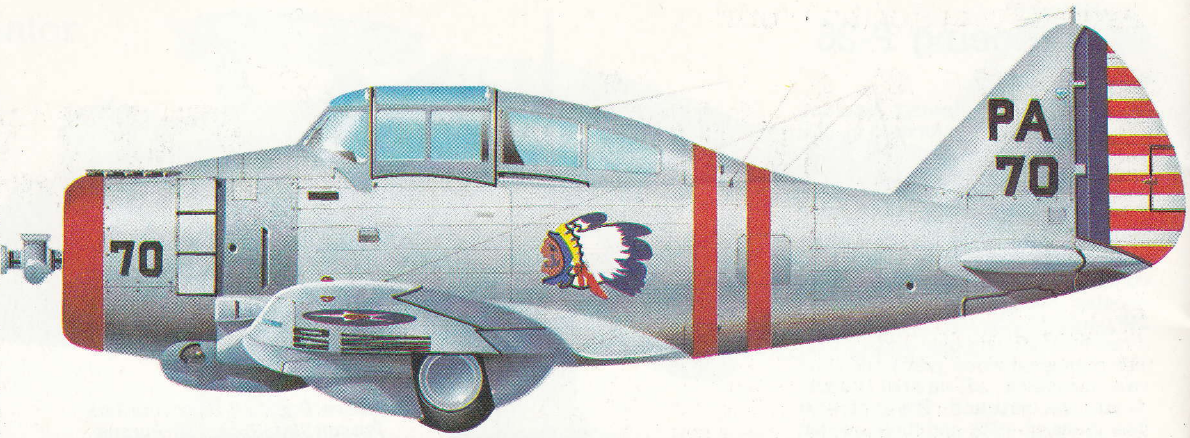


A typical USAAC line-up of the 27th Pursuit Squadron displaying their Seversky P-35s at Selfridge Field, Michigan. The aircraft was too stable to be an effective fighter and was outclassed by the opposition before it was delivered.

Seversky P-35 (continued)

Though having a modern stressed-skin airframe and comfortable cockpit, the landing gears did not retract fully (folding backwards), pilots disliked being enclosed, and the P-35 was too stable for success in dogfighting unless the pilot was very strong. By the time they were delivered these machines were already outmoded on the grounds of speed and firepower.

In June 1939 Sweden ordered 15 (later increased to 120) of the **EP-1** version with two heavy-calibre machine-guns in the wings and with the 1,050-hp (783-kW) Twin Wasp R-1830-45 engine. In October 1940 the US government requisitioned the final 60, and 45 of these **P-35A** aircraft went to the Philippines where in December 1941 they were outclassed by the Japanese Mitsubishi A6M and Nakajima Ki-43. They lacked armour, self-sealing tanks, speed and firepower, and in any case most were destroyed in attacks on their airfields.



Seversky P-35 flown by the CO of the 27th Pursuit Squadron, 1st Pursuit Group at Selfridge Field. It had some unpleasant flight characteristics, such as falling away in a spin at high altitudes, but was liked by its pilots on account of its roomy cockpit and docile landing.

Specification

Seversky P-35

Type: single-seat fighter or (P-35A) fighter-bomber

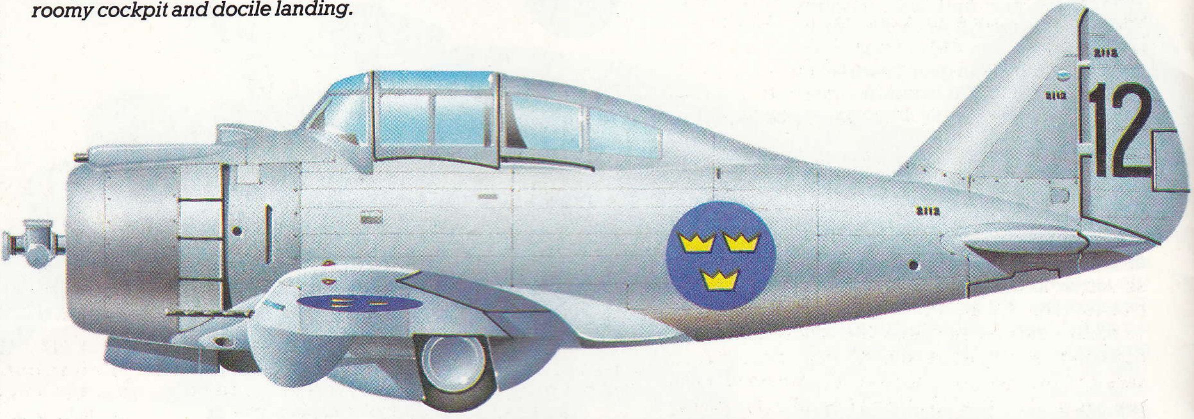
Powerplant: one 950-hp (708-kW) Pratt & Whitney Twin Wasp R-1830-9 14-cylinder two-row radial piston engine

Performance: maximum speed 452 km/h (281 mph) at 3050 m (10,000 ft); climb to 4570 m (15,000 ft) in 6 minutes 54 seconds; service ceiling 9325 m (30,600 ft); range (full 757 litres/166.5 Imp gal) 1850 km (1,150 miles)

Weights: empty 1957 kg (4,315 lb); maximum take-off 2855 kg (6,295 lb)

Dimensions: span 10.97 m (36 ft 0 in); length 7.67 m (25 ft 2 in); height 2.77 m (9 ft 1 in); wing area 20.44 m^2 (220 sq ft)

Armament: one 7.62-mm (0.3-in) and one 12.7-mm (0.5-in) Browning machine-guns above nose



An improved version of the P-35 was purchased by Sweden. Known as the EP-1, 60 were delivered and flew in a number of paint schemes such as natural metal and a variety of brown and green mottles. Sixty further EP-1s were taken over by the USAAF and flown as P-35As.

USA

Grumman F3F

Leroy Grumman formed his Grumman Aircraft Engineering Corporation on the strength of a patented type of seaplane float into which landing wheels could retract, one wheel into each side of the large float strut. It was but a natural step to apply this retractable gear to a fighter, and the result was the **Grumman FF-1**, flown in late 1931. Grumman managed to overcome the penalties of shipboard operation and still achieve a fighter faster than anything then in the US Army inventory. From it was derived the **F2F**, which entered service aboard the USS *Lexington* in February 1935. Powered by a slim Twin Wasp Junior, this had the typical tubby fuselage and sliding canopy of the FF-1, and in many respects was outstandingly modern, but stability and handling were marginal.

In March 1935 the prototype **F3F** introduced longer-span wings and a longer fuselage which vastly improved handling and resulted in one of the best fighters of the day. Though the airframe was of traditional form it was immensely strong (the 'Grumman Iron Works' got its name from its strong aircraft) and very popular. Like all US Navy fighters of the day the F3F had exceptional fuel capacity, and moreover it could carry bombs and was unrestricted in dive steepness. By 1937 the **F3F-2** was being delivered, with the Wright Cyclone engine which though of much greater diameter was also considerably more powerful. Perhaps ill-advisedly a further batch, designated **F3F-3** with small refinements, was ordered for delivery in early 1939, by which time the basic type was outdated. But then the next-generation F4F Wildcat was originally designed as a biplane.

Specification

Grumman F3F-3

Type: single-seat carrier-based fighter-bomber

Powerplant: one 950-hp (708-kW) Wright Cyclone R-1820-22 nine-cylinder air-cooled radial piston engine

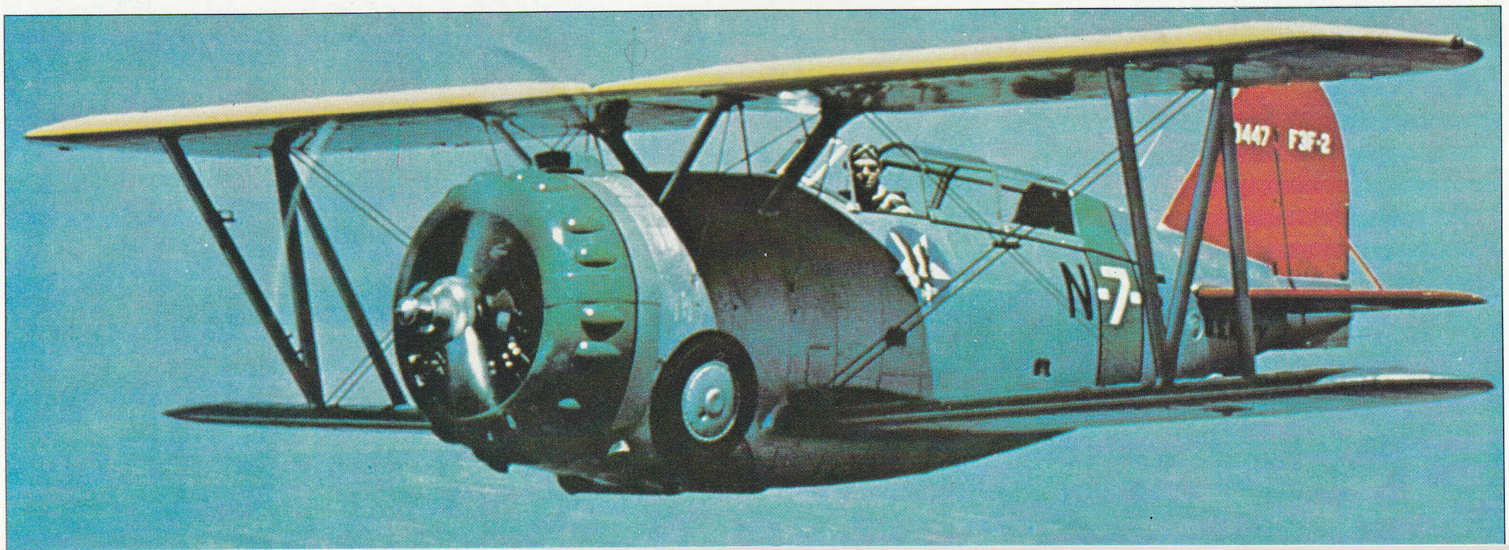
Performance: maximum speed 425 km/h (264 mph) at 4635 m (15,200 ft); climb to 3050 m (10,000 ft) in 4 minutes; service ceiling 10120 m (33,200 ft); range 1850 km (1,150 miles)

Weights: empty 1490 kg (3,285 lb); maximum take-off 2175 kg (4,795 lb)

Dimensions: span 9.75 m (32 ft 0 in); length 7.01 m (23 ft 0 in); height (over propeller) 2.84 m (9 ft 4 in); wing area 24.21 m^2 (260.6 sq ft)

Armament: one 7.62-mm (0.3-in) Browning machine-gun and one 12.7-mm (0.5-in) Browning machine-gun, plus two 52.6-kg (116-lb) bombs

Despite its biplane configuration, the Grumman F3F had a very neat retractable undercarriage, and was one of the first multi-role fighters, being able to carry out both fighter and dive-bomber missions. It was immensely strong and paved the way for the F4F Wildcat.



US Marine Corps

Marine Aviation

The three active force Marine Aircraft Wings have a combined manpower strength of 35,600 men plus a front-line aircraft strength of about 440 aircraft and 102 armed helicopters. Pride of place goes to the fighter squadrons, of which there are 12. In the mid-1970s, the US Marines sought the Grumman F-14A Tomcat for their front-line squadrons, but were forced by Congress to wait longer for a new generation fighter. The F-14A never became part of the US Marine Corps inventory, but because of that disappointment the US Marine Corps was able to win an early place in receiving the McDonnell Douglas F/A-18 Hornet. Three F/A-18 squadrons are now operational. The remaining nine fighter squadrons fly the McDonnell Douglas F-4N and F-4S Phantom. The ageing F-4N model will be retired by February 1985.

The US Marine Corps has 13 attack squadrons, three of which are equipped with the AV-8 Harrier. Though plagued by a series of crashes early in its American incarnation, the Harrier has always enjoyed the full support of US Marine flyers themselves, who now have total confidence in its capabilities. The AV-8C Harrier, a slightly improved version of the operational AV-8A, is now under test. Far more advanced is the AV-8B, the big-wing version of the Harrier scheduled to enter operational service in 1985. The US Marine Corps' 10 remaining attack squadrons include five each with the McDonnell Douglas A-4M Skyhawk and the all-

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The US Marine Corps operates a full range of aircraft, from fighters and strike aircraft to tankers, transports and helicopters. Air power is crucial to the success of amphibious operations; the fleet must be defended from hostile air attack and air support provided for the Marines ashore.

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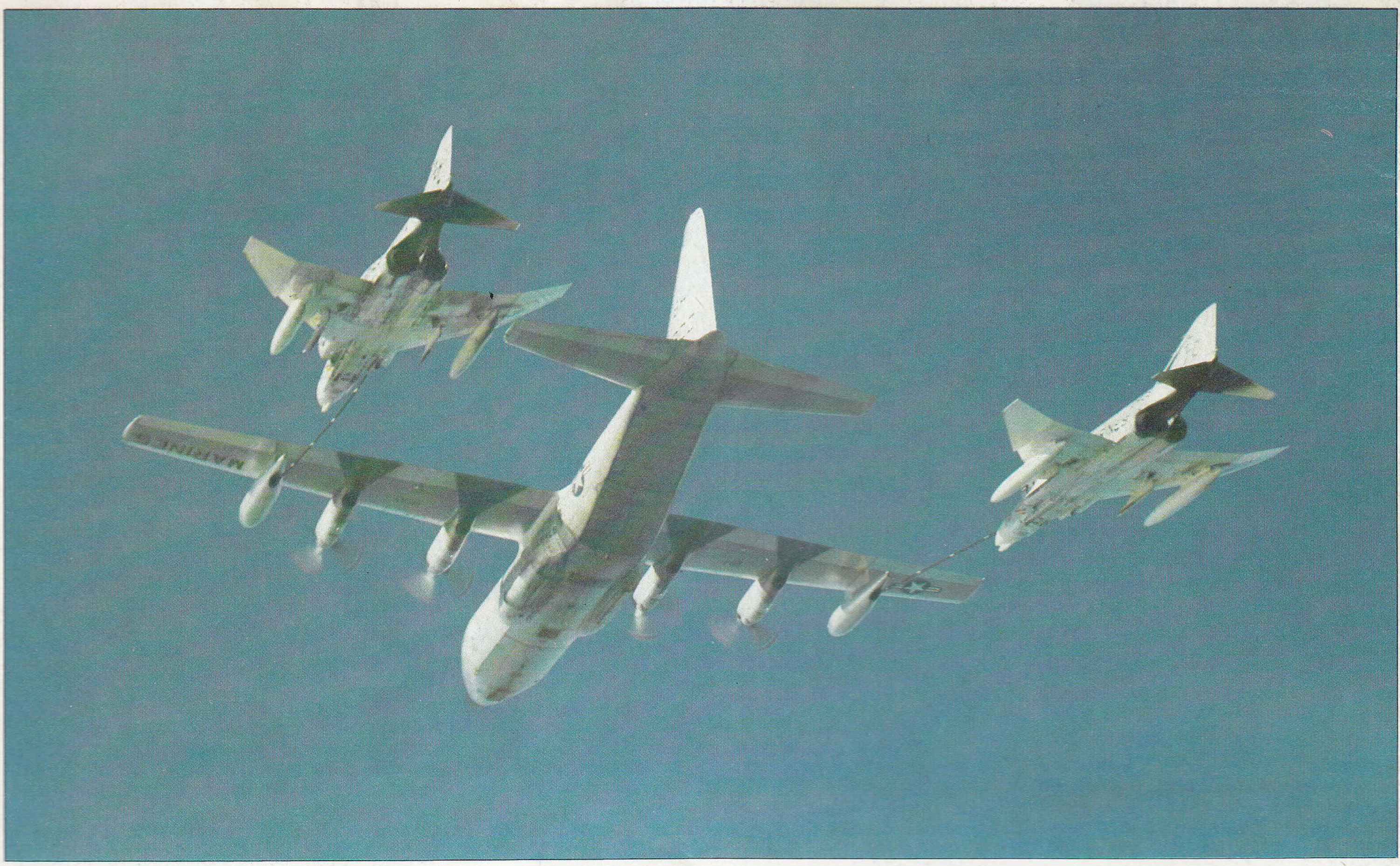
A Bell AH-1T SeaCobra escorts a UH-1N 'Huey'. The SeaCobra is armed with TOW anti-tank missiles and a three-barrelled 20-mm cannon capable of firing up to 1,500 rounds per minute. The 'Huey' is a general-purpose transport and is normally unarmed.

12 PASS



The Vietnam War saw the Marine Corps develop an inflight-refuelling capacity for the first time. Today, Marines may be committed at short notice to far-flung corners of the globe, so air support over long distances remains important.

weather Grumman A-6E Intruder. The US Marines have a single photo-reconnaissance squadron flying the RF-4B Phantom and an electronic warfare squadron operating the EA-6B Prowler. All of these air units are expected to maintain the capability to operate from US Navy carrier decks, and periodically deploy to carriers as part of an embarked Navy Carrier Wing.

Standing behind the combat squadrons are the no less important support squadrons. Two of these are Rockwell OV-10D Bronco observation squadrons, and there are also several headquarters and maintenance squadrons with TA-4J and OA-4M Skyhawks. Lockheed KC-130F, KC-130R and KC-130T Hercules aircraft serve with three assault transport and tanker squadrons. Limited numbers of C-9B, North American CT-39G and Douglas C-117D aircraft meet more mundane utility transport and 'hack' requirements.

The US Marine Corps has no fewer than 25 operational helicopter squadrons. Eight of these use the heavy Sikorsky CH-53D and CH-53E, and the US Marine Corps has 168 of these large helicopters with more on order. There are 180 CH-46E And CH-46F Sea Knights distributed among 11 squadrons and a couple of training units. The universal 'Huey' is used in the transport role, there being three Bell UH-1N squadrons, and a further three squadrons are equipped with the AH-1T SeaCobra for the armed offensive role, carrying TOW anti-tank missiles. Finally, the US Marine Corps contributes a special VIP squadron to the USAF's 89th Military Airlift Wing at Andrews AFB, Maryland, operators of the President's 'Air Force One' which becomes 'Marine One' when the chief executive is flying aboard a US Marine Corps aircraft; this squadron is equipped with the VH-53D, VH-46F and VH-1N, all of which have been seen landing on and taking off from the White House lawn.

The US Marine Corps also has two air-defence battalions equipped with the Improved HAWK heavy anti-aircraft missile.

The US Marine Air Reserve is kept at a high state of readiness and its 4th Marine Aircraft Wing is formed from four aviation groups, one service group, and one air control group. The 11 aircraft-operating squadrons of the Reserve are equipped with F-4N and F-4S Phantoms, A-4E, A-4F and A-4M Skyhawks, the EA-6A intruder, and the OV-10 Bronco. A combined tanker/assault squadron uses 12 KC-130Fs and is receiving the new KC-130T model ahead of active-duty units. There are 10 US Marine Reserve helicopter squadrons. One of these uses the armed AH-1J, and there are two squadrons operating the UH-1E/UH-1N 'Huey' in the light transport helicopter role. For heavy lift tasks, there are three squadrons with the CH-53A and a further four squadrons operate the CH-46. The Reserve also has an air-defence battalion equipped with the HAWK heavy anti-aircraft missile, and there are a further 32 or so support units of one type or another.

The support units

The US Marine Corps has to operate a large number of support units in addition to the combat and air arms. These units accomplish such functions as transport (equipped with much the same types of wheeled transport as the US Army), fuel supply and distribution, special signalling, equipment holding, special maintenance and rearming. Normally, these variegated units are attached to MAUs and other units as and when required, but one special grouping is maintained at Camp Pendleton, California, for the specific support of the 7th Marine Amphibious Brigade and the 1st Marine Division as part of the RDJTF. This is the 1st Force Service Support Group. It contains among its various components a number of units equipped with material-handling equipment that ranges from massive 140-ton cranes to container-handling tractors.

Detachments of US Marines provide security on board US Navy ships, at naval bases, and at 118 embassies and consulates in 103 countries. Service with a Marine Security Guard (MSG) detachment at a US embassy is a sought-after perquisite. But in recent years, MSG members have been held prisoner in Tehran and killed or injured in rioting in Pakistan and Libya.

The future

The US Marine Corps enjoys the support of the administration and the American public, even when committed to a controversial cause, as in Lebanon. The US Marine Corps has the training, preparedness, mobility and firepower to fight and win on almost any far-flung battlefield. With improved artillery and armour support, and enhancement of its combat service support elements (the latter having purposely been given top priority) the US Marine Corps has an assured future. A large proportion of the strength of the US Marine Corps is now involved with the RDJTF and is thus always kept at a high state of readiness. New equipment for this and other roles is on the way. The turmoil and violence of these troubled times will almost certainly guarantee the US Marines a place in the public eye for the foreseeable future. While their long history of achievement on the battlefield is an established matter of record, members of the US Marine Corps believe (and seem to be right) that they will have ample opportunity to add future achievements to their long list of laurels.